THE IRON TRADE REVIEW

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THE WEEK IN IRON CIRCLES.

THE MARKET AT LARGE.

The buoyant feeling in the iron trade is more pronounced and the past week has added new elements of strength. Prices on Bessemer iron are already above those for the corresponding week in 1899; in foundry and forge irons they are still slightly below the market in the third week of March of that year. Bessemer steel is about $2 lower than at that time, sheets $16 a ton higher, structural material $2 a ton higher, plates $10 a ton lower and bars $1 to $2 a ton higher. Consumption of pig iron as shown by the blast furnace figures, is now at a yearly rate of 3,000,000 tons more than in March, 1899, being today close to the highest on record. At the beginning of this month, with 248 furnaces active, production was at the rate of 292,899 tons a week, as against 298,014 tons from 296 furnaces on Feb. 1, 1900, when high point was reached. Just where the price line lies at which any considerable addition will be made to the number of active furnaces is a question the trade would gladly have answered. It is safe to say that the advance may go yet further without causing any measurable stir in the idle list. As in all previous upward movements the East is slow to catch step, and the life shown in Central Western markets is scarcely appreciated on the seaboard. Sales of foundry pig iron were made in Eastern Pennsylvania at practically the low point of this year. Southern sellers advanced their price further last week and are now generally asking $11.50 at Birmingham for No. 2 foundry. This basis puts them out of competition with Northern irons in some districts. Bessemer, basic and forge irons have been active in the Pittsburg market. The leading interest bought 20,000 tons of basic for midsummer deliveries. Another large consumer bought Bessemer at $16 Valley furnace, and enough forge iron was sold to bring the total of steel works and mill irons to 50,000 tons. Coke production reflects the activity at furnaces and foundries, and coke prices are advancing further. It is estimated that 375,000 tons of Bessemer iron have been sold by Valley furnaces since the opening of the year. Though much of this was at the low January price, furnace workers are already agitating for the restoration of the 10 per cent taken from their wages Feb. 1 and a meeting has been called for this week. Furnacemen have no knowledge as yet as to the Bessemer ore basis, but it is probable prices will be announced within the coming week. The wait has been in part to see the definite carrying out of the plans of the Morgan syndicate, concerning which official announcement is expected this week. Activity in Lake Superior mining properties is a feature of the week. The purchase of the Rockefeller mines, railroad and vessels for the United States Steel Corporation is taken as a practically accomplished fact, and it is known that overtures have been made also for the purchase of important mines on the Menominee and Marquette ranges. The big consolidation is seriously after all the good mines now in independent hands and its program in this particular is a most comprehensive one. Reports from finished material markets show firmer conditions in the week, with advances in some products, notably black sheets, which are $3 a ton higher. The heavy demand for wrought pipe, including good foreign orders, has resulted in an advance on jobbers' stocks, but no announcement has been made by the leading producer. Plates and bars show further strength. In the latter leading mills are well sold ahead and important agricultural and car works requirements are yet to be covered. Advances in wages will be asked by the Amalgamated Association at its May convention, for all classes of workers, and it is believed provision will be made by which operations will continue, pending the scale settlement each year. Apprehension is felt, however, for the outcome of the demands that will be made in April in the machinery trade for a 9-hour day with 10 hours' pay.

PITTSBURG.

(*Special Telegram*)

PITTSBURG, PA., March 20.—A sale of 5,000 tons of Bessemer iron for March and April delivery was made today at $17.25 Pittsburg, equivalent to $16.50 at Valley furnace.

OFFICE OF *The Iron Trade Review*,
429 PARK BUILDING, March 20.

The iron and steel market continues to gain strength daily and producers quote prices from day to day only, owing to the frequent advances that are being made in all lines. The buying of pig iron the past week in this district has been particularly heavy, amounting to nearly 50,000 tons. The purchase of 20,000 tons of basic by the Carnegie Steel Co. for delivery during June, July and August would indicate that a scarcity of this iron is looked for during the summer months and that the leading consumer is intrenching against further advances. The sales of Bessemer iron in the week amounted to about 15,000 tons at an advance of 25 cents a ton. There has also been heavy buying of forge iron amounting to about 11,000 tons, mostly Northern. Skelp has been advancing at a surprising rate, narrow grooved iron skelp selling as high as 2 cents during the past few days. Muck bar is also a scarce commodity and offers of $28 and $29 a ton have been made for small lots. Steel billets in small lots continue to command higher prices almost daily. We note sales of about 900 tons of Bessemer billets at $23.50 to $24 per ton. Open-hearth billets are almost entirely out of the market, although a few small sales for immediate delivery have been made at $27. One of the large sales of the week was that of 10,000 tons of re-rolling rails at prices ranging from $14.50 to $16. Light rails continue very scarce and the coal people are offering considerable premiums for immediate delivery. For 10-pound rails as high as $32 has been paid while 12-pound rails are held at $34. Not since 1899 have the Bessemer furnaces in the Valleys had as much iron booked in March for delivery during the first half as at the present time. It is estimated that their total sales for delivery to July 1 at present amount to 375,000 tons and but for the large stocks on hand at all the furnaces at the first of the year the furnaces would already have been practically sold up.

The American Sheet Steel Co. last week announced an advance of $3 per ton in the price of black sheets to take effect immediately. This is an advance of $7 per ton in about three weeks. Galvanized sheets, however, are unchanged, but an advance is looked for daily by the trade.

The absorption of the Rockefeller ore interests by the United States Steel Corporation is considered a strong move, and the latest announcement is that the American Bridge Co. is to be included in the consolidation as originally announced. Despite reports from New York to the effect that certain stockholders in some of the constituent consolidations are objecting to the terms offered them, we have been in-

formed that sufficient stock has already been exchanged to insure the launching of the new company on April 1.

It was reported this week that the National Tube Co. was about to announce an advance in prices. No such move has been decided upon as yet nor will an advance be made until market conditions warrant it. The report that options have been withdrawn is absolutely without foundation as the National Tube Co. has never given options on its product since its organization. We have been advised, however, that jobbers have advanced their prices from 2 to 5 per cent anticipating an advance and that a number of independent mills have made similar advances. As a feature of the week the record-breaking production of the Connellsville region must not be overlooked. During the week ending Saturday, March 9, the total estimated production of this region amounted to nearly 230,000 tons, breaking all records made in the early part of last year by more than 10,000 tons. Despite this big production there is already a scarcity of coke, and consumers are beginning to make the price with the result that the market is advancing. The settlement of the bar iron scale for the months of March and April has resulted in an advance of 12½ cents a ton; the first advance made since the adoption of the new scale last summer. Today the last reports from the various sub-lodges of the Amalgamated Association giving suggestions to be acted upon at the annual convention were received. The lodges are almost unanimously in favor of the insertion of the non-interruption clause in the scale provided a suitable base can be decided upon. By the insertion of this clause the plants of the country, recognizing the Amalgamated Association will be permitted to continue operation during the summer months and if a suitable base is decided upon there will probably be no necessity of the annual wage settlements which have always proved one of the chief uncertainties in the iron trade.

PIG IRON.—The Carnegie Steel Co. last week again made purchases of basic iron, a total of 20,000 tons at $15.50, Pittsburg. Less than a month ago purchases were made amounting to nearly 75,000 tons at $14, Pittsburg. Gray forge iron was in excellent demand the past week 11,000 tons having been sold at $14.25 to $14.50 per ton. The buying of Bessemer iron was also heavy, amounting to 15,000 tons at $16 and $16.25, at the furnace. The Southern furnaces have made another advance on forge and foundry irons, and are again unable to meet the competition of the Northern furnaces in this district, although a limited amount continues to be sold for mixtures. The sales of Bessemer iron thus far amount to 375,000 tons for delivery to July 1. Inasmuch as there are 13 independent furnaces in the valleys, eleven of which are members of the Bessemer Association, with an output of about 900,000 tons annually, it can be seen that these furnaces are pretty well sold up, despite the fact that a large stock of iron was on hand at the first of the year. The fact that these furnaces are not constantly on Bessemer must also be taken into consideration, as many of them produce more foundry and forge iron than Bessemer. The sales of foundry irons the past week were very limited, amounting to about 1,000 tons at $14.75 to $15 per ton. We revise as follows:

Bessemer, Valley	$16.00 to 16.25
Bessemer, Pittsburg	16.75 to 17 00
No. 1 Foundry	15.25 to 15.50
No. 2 Foundry	14.75 to 15.00
No. 3 Foundry	14.25 to 14.50
Gray Forge, Pittsburg	14 25 to 14.50

STEEL.—Steel billets for prompt shipment continue to grow scarcer daily and consumers that are hard pressed increase their premiums over agreed quotations proportionately. We note sales of 900 tons of Bessemer billets at $23.50 to $24 a ton. Open-hearth billets are almost an unknown quantity and small lots have sold as high as $27 and $28 per ton. Sheet and tin bars cannot be secured by the trade at any price. The pool quotations continue as follows: 4x4 billets, delivered Pittsburg, Wheeling or Valley at $19.75. On less than 4-inch billets down to 1½-inch $1 extra is charged Open-hearth billets are $ 1 per ton above Bessemer billets at all delivered points. Sheet and tin bars are $1 above Bessemer billets.

FERRO-MANGANESE.—The price of manganese continues unchanged. We quote 80 per cent domestic at $62.50 per ton delivered at buyer's mill.

RAILS AND TRACK MATERIAL.—The operation of the plant of the Potomac Steel Co., at Cumberland, Md., by Jos. Schonthal will relieve the light rail market to some extent. Prompt deliveries are almost impossible at present and with the opening of many new coal mines in the bituminous districts in this vicinity there is an immense demand. The prices have again been advanced during the past week and there is every indication that further advances will be made. The demand for track material continues good, as much railroad work is laid out for the spring and summer. We revise quotations as follows: Rails, standard sections, 50 pounds and over, in lots of 200 tons and over, $26; car lots and less than 200 tons, $28; less than car lots, $30; light rails, 12 pounds, $34; 16 to 20 pounds, $32; 25 to 40 pounds, $31. Track material: Spikes, 1.95c to 2c; track bolts, square heads, 2.50c; hexagon heads, 2.60c; fish plates, 1.60c to 1.70c.

SPELTER.—There has been little change in the spelter market the past week and we quote prime western grades at 3.95c, Pittsburg.

BARS.—The demand for steel bars continues strong and producers will not make quotations for delivery beyond 60 days. For carload lots the producers are uniformly holding to 1.45c to 1.50c, and for less than carload lots as high as 1.55c to 1.60c is asked. Common iron bars are held at 1.45c to 1.50c, Pittsburg and refined bars are held at 1.75c.

STRUCTURAL MATERIAL.—Considerable new business in structural material is being placed owing to an impending advance. Much large business is about to be placed and it is probable that it will be closed up shortly as present prices cannot rule much longer with advances in other lines. We make the following quotations: Beams and channels, 3 to 15 inches, 1.50c; 18 to 24 inches, 1.60c; tees, 1.55c; zees, 1.50c; angles, from 3 to 6 inches, 1.40c; universal mill plates, 1.50c.

MUCK BAR.—This is one of the scarcest commodities in the entire market and small sales have been made during the past week at $28 to $29 per ton.

SKELP.—The skelp market has been making wonderful strides during the past few days and narrow widths of grooved skelp are held at 2c, while wider material is held at 1.90c. Sheared iron skelp sells at $1 above grooved. Steel skelp, both grooved and sheared, has advanced to 1.75c to 1.80c.

PLATES.—Fully 5,000 tons of plates were contracted for last week among local mills and consumers, anticipating further advances are placing their business, rather than hold off any longer. The following quotations are being made by all plate manufacturers: Tank plate, ¼-inch thick up to 100 inches in width, 1.50c at mill, Pittsburg; flange and boiler steel, 1.60c; marine, ordinary firebox, A. B. M. A. specifications, 1.70c; still bottom steel, 1.70c; locomotive firebox, not less than 2c; and it ranges in price to 3c. Plates more than 100 inches wide, 5 cents extra 100 pounds. Plates 3-16 of an inch in thickness, $1 extra; gauges Nos. 8 and 9, $2 extra. These quotations are based on carload lots, with 5 cents extra a hundred pounds for less than carload lots. Terms, net cash in 30 days.

PIPES AND TUBES.—We have been advised by the National Tube Co. that no advance in pipes and tubes has been decided upon to be made at any specified date despite reports to the contrary. While the market is very strong at present no advances have yet been announced. Jobbers, however, anticipating an advance are holding prices at from 2 to 5 per cent above ruling quotations. We have also been advised that a number of independent mills have also advanced their prices. The largest producer continues to make the following quotations to consumers in carload lots, Pittsburg:

MERCHANT PIPE.

	Carload lots. Black Per cent.	Carload lots. Galv. Per cent.	Less than carload lots Black Per cent.	Less than carload lots Galv. Per cent.
⅛ to ⅜ and 11 to 12 in	59.2	46.2	54.9	40.9
½ to 10 inches	66.7	53.3	61.9	49.9

BOILER TUBES.

	22 Feet and under. Per cent. Iron.	22 Feet and under. Per cent. Steel.	Over 22 Feet. Per cent. Iron.	Over 22 Feet. Per cent. Steel.
1 to 1¾ and 2¾ to 5 inches, inclusive	49½	68¼	44½	65
2 to 2¼ inches, inclusive	45	63	39½	58
6 inches and larger	57	69	52¼	58

CASING.

	S. and S., per cent.
2 to 3 inches	58
3¼ to 4 inches	65
4½ to 12½ inches	65

O. D. PIPE.

	Per cent.
14 to 22 inches	42
24 inches, o. d. and larger	37

THREADS AND COUPLINGS.

	Per cent
14 to 16 inches o. d	35

SHEETS.—As anticipated the American Sheet Steel Co. has made another advance in the price of sheets. Last Saturday an advance of $3 per ton was announced on black sheets, making a total of $7 per ton within the past two weeks. Quotations for delivery beyond 60 days will not be made. Galvanized sheets, however, have not been advanced, although such a move is looked for by the trade. We make the following quotations on carload lots. Black sheets, one pass through cold rolls, No. 30, 3.65c; No. 29, 3.55c; No. 28, 3.35c; No. 27, 3.25c; Nos. 25-26, 3.15c; Nos. 22-24, 3.05c; Nos. 19-21, 2.95c; Nos. 17-18, 2.80c; Nos. 15-16, 2.70c; Nos. 13-14, 2.60c; Nos. 10-12, 2.50c. For more than carload lots a reduction of 5 cents per 100 pounds is made and for less than carload lots an advance of 15 cents per 100 pounds over the above prices is asked. Galvanized sheets are strong at 70 and 5 to 70 off.

OLD MATERIAL.—The largest sale of old material the past week was that of 10,000 tons of rails for re-rolling purposes. Other material is moving slowly owing to the dealers' disposition to hold material for higher prices. We revise quotations as follows: Heavy melting stock, $16.50 to $16.75; low phosphorus melting stock, $19; steel rails, $16.50 to $17; busheling scrap, $15 to $15.25; No. 1 wrought, $17 to $18; iron rails, $22 to $23; cast borings, $8; cast scrap, $14.25 to $14.50; relaying rails with joints, $23.

WIRE AND WIRE NAILS.—During the past few days there has been an immense increase in business among the jobbers and prices on wire products generally are very firm. Prices are unchanged as follows: Single carloads of wire nails to jobbers, $2.30 in Pittsburg; to retailers, $2.40. Plain wire, carload lots, is now quoted at $2.25 to jobbers and $2.35 to retailers; painted barb wire, $2.60, in carload lots to jobbers, and $2.70 to retailers; galvanized barb wire, $2 in carload lots to jobbers, and $3 to retailers. Cut nails are quoted at $2, Pittsburg, in carload lots, 2 per cent off in 10 days.

MERCHANT STEEL.—The demand for shafting is reported very strong although quotations continue unchanged. Demand for tool steel is reported excellent and considerable buying is reported. We revise quotations as follows: Turned, cold rolled and ground shafting at 55 per cent off for car lots and 50 per cent off for less than car lots; tire steel in carload lots and over, 1.60c; less than carload lots, 1.65c. Toe calk is held at 1.75c in large lots, and in small lots as high as 1.80c. Tool steel is held at 7c and upwards, according to quality; hoops and bands, 1.95c to 2c.

COKE.—The coke market continues to grow stronger daily and strictly Connellsville furnace coke is held firm at $2 per ton while outside coke is selling as high as $1.75 and $1.85 per ton. Connellsville foundry coke is quoted $2.50 per ton and outside foundry at $2.25. For the week ending March 9, the output of the Connellsville region amounted to 229,035 tons, which breaks all previous records. The shipments for the week aggregated 10,747 cars, an increase of nearly 400 cars over the previous week.

CHICAGO.

OFFICE OF *The Iron Trade Review*,
1522 MONADNOCK BLOCK, March 19

The inquiry for material is almost universally in excess of supply. From a multitude of sources come the statement that consumers are short of the iron and steel necessary to keep their works in operation, or if not that they desire to provide for their future needs. However, there is nothing approaching the eagerness to buy shown under similar conditions two years ago. Perhaps the memories of the succeeding year are fresh in the minds of these buyers. The consumers are standing up under fire like veterans this time. Where there are changes in quotations, they are upward. Black sheets have advanced $3 per ton; steel bars are generally quoted $2 per ton higher; plates are slightly stronger and billets are nominally about $2 above the level of a week ago. Old material is rising and pig iron sells at a range 25 to 50 cents higher.

PIG IRON.—The continued good buying during the past three weeks has had its effect on prices and upon supply. The local irons are becoming decidedly scarce. Some furnaces are sold up to September, some to August and others to July. Very little pig iron is procurable for shipment during the ensuing three months. Yet the demand seems to be about as urgent as ever. The aggregate sales of the past week may not have been so large as those for the preceding week, certainly not so large as those of two weeks ago, but easily reached 20,000 or 30,000 tons, and it is becoming more and more apparent that the total transactions of the past three weeks have been very large. As it looks at present, it is difficult to see just where the lagging buyers will be able to secure their supplies. One large producer remarks that during the past ten days he has turned down more business than he has accepted, simply because he could not make the desired deliveries. One or both the Bay View furnaces will soon run on Bessemer iron for a short time, though not long enough to interfere with foundry obligations. One of the new furnaces of the Illinois Steel Co. at South Chicago will be ready for operations, it is expected, by June 1. Revised quotations follow:

Lake Sup. Charcoal	$17 50 to $19 00	Southern Coke No. 4	$14 50 to $14 65
Local Coke Fdy. No. 1	16 00 to 16 50	Southern No. 1 Soft	15 65 to 16 15
Local Coke Fdy. No. 2	15 50 to 16 00	Southern No. 2 Soft	15 15 to 15 65
Local Coke Fdy. No. 3	15 00 to 15 50	Southern Silveries	15 65 to 16 15
Local Scotch Fdy. No. 1	16 00 to 16 50	Jackson Co. Silveries	17 50 to 18 50
Local Scotch Fdy. No. 2	15 50 to 16 00	Ohio Strong Softeners	16 50 to 17 00
Local Scotch Fdy. No. 3	15 00 to 15 50	Alabama Car Wheel	21 00 to 22 00
Southern Coke No. 1	15 65 to 16 15	Malleable Bessemer	15 50 to 16 50
Southern Coke No. 2	15 15 to 15 65	Coke Bessemer	17 50 to 18 50
Southern Coke No. 3	14 65 to 15 75		

BARS.—Most if not all makers of steel bars are now holding prices steady at 1.65c, Chicago, an advance of $2 per ton. Moreover they are not generally quoting on shipments before July 1. Current transactions denote some solicitude on the part of large buyers, with indications that some of them are anticipating their supposed wants. A few contracts are being entered for shipment during July and succeeding months. Iron bars also are firm, with upward tendency. A common quotation is 1.55c and some material has been sold at a higher price.

STRUCTURAL MATERIAL.—Transactions involving beams and channels are generally below the thousand ton mark, though between that amount and several hundred tons there is a fair business, going into miscellaneous uses. The big building trade continues shy in comparison with the records made in other products, but the future looks bright for a heavy tonnage. Quotations are unchanged as follows: Beams, 15 inches and under, 1.65c; 18 inches and over, 1.75c; angles under three inches, 1.40c to 1.45c; over six inches, 1.65c; three inches to six inches, 1.55c; plates, 1.55c; tees, 1.70c; zees, 1.65c; small lots from store are quoted ¼c to ½c higher.

RAILS AND TRACK SUPPLIES.—Perhaps 10,000 tons of rails were sold in the week. Prices are firm for both light and standard sections and for track supplies. Quotations are as follows: Rails, standard sections, $26; light sections, $26 to $29; splice bars, 1.45c to 1.55c; spikes, 1.75c to 1.85c; track bolts, hexagon, nuts, 2.65c to 2.75c; square nuts 2.45c to 2.55c.

PLATES.—The mill at South Chicago has resumed and demand continues very heavy, larger than the capacities of production for early needs. Prices are strong. We quote as follows: Mill shipment, Chicago delivery, tank steel, 1.65c; flange steel, 1.75c; marine steel, 1.85c; fire-box steel, ordinary, 1.85c; fire-box, special, 2.25c and upwards.

BILLETS AND RODS.—One inquiry of 12,000 tons of billets found no taker. Mills are sometimes quoting on some sizes and declining on others. The market is irregular, owing to the particular circumstances of each case. Bessemer billets ranging from $24.50 to $26. There is no quotable market for rods.

SHEETS.—Black sheets were marked up $3 per ton this week and mills are overburdened with business. Galvanized sheets are nominally unchanged, but actual selling prices are higher. No. 27 black is quoted at 3.35c from mill and galvanized is held at 70, 5 and 2¼ per cent Chicago.

MERCHANT STEEL.—Mills are importuned for shipments that are impossible and stocks are absorbed as fast as they appear. The condition of the market is one of great strength. Quotations, mill shipments, are as follows: Chicago delivery: Smooth-finished tire steel, 1.90c to 1.95c; open-hearth spring steel, 2.15c to 2.40c; toe calk, 2.40c to 2.55c; sleigh shoe, 1.70c to 1.80c; cutter shoe, 2.40c to 2.55c; ordinary tool steel, 6c to 7c; specials, 13c and upwards. Cold rolled shafting, 55 per cent discount.

MERCHANT PIPE.—The situation is practically unchanged,

prices remaining the same. If there is any change in the demand it is increasing. Random lengths are quoted as follows, Chicago delivery:

MERCHANT PIPE.

	In carloads		Less than carloads.	
	Blk.	Galvd.	Blk.	Ga'vd.
⅛ to ⅜ inch and 11 to 12 inches	59.2	46.2	54.9	40.9
½ to 10 inches	66.7	53.3	61.9	49.9

WIRE AND WIRE NAILS.—The condition of mills tells the tale. They are running night and day and on Sunday as well. There has accumulated a large bunch of orders, which refuses to diminish in size, notwithstanding the heavy production. Prices are firmly held at old quotations, namely: Single carloads of wire nails to jobbers, $2.40; Chicago, to retailers, $2.50; plain wire, carloads, to jobbers, $2.35; to retailers, $2.45; painted barb wire, to jobbers, carloads, $2.70; to retailers, $2.80; galvanized barb wire, carloads, to jobbers, $3; to retailers $3.10.

OLD MATERIAL.—Holders, looking to the general conditions in the crude material markets, are holding their possessions at good figures compared with recent levels and business is not very active. While there is considerable irregularity and uncertainty as to prices the tendency is distinctly upward, considering the market as a whole. Dealers' selling prices per gross ton are as follows;

INSERT NONP

Old iron rails	$18 50 to $19 00	Old wheels	16 50 to 17 00
Old steel rails, long	14 00 to 14 50	Heavy melting steel	14 00 to 14 50
Old steel rails, mixed	11 00 to 12 00	Mixed country steel	10 00 to 10 50
Relaying rails	20 00 to 22 00		

The following are selling prices per net ton:

No. 1 R. R. wrought	15 00 to 15 50	Iron axles	18 00 to 19 00
No. 2 R. R. Wrought	13 00 to 13 50	Cast borings	3 00 to 3 50
Dealer's forge	12 50 to 13 00	Wrought turnings	8 50 to 9 00
No. 1 bushelling	9 75 to 10 00	Iron axle turnings	9 00 to 9 50
Heavy cast	11 50 to 12 00	Steel axle turnings	8 00 to 8 50
Railway malleable	11 50 to 12 00	Stove plates	7 50 to 8 00
Country malleable	10 00 to 10 50	Old iron splice bars	16 50 to 17 00

CLEVELAND.

OFFICE OF *The Iron Trade Review*,
1064 ROSE BUILDING, March 20.

The 20th of March, the date fixed by the Morgan syndicate for the deposit of stock in the various steel consolidations, has had some significance in the ore trade, as well as in other branches. Buyers of ore have wanted to see what came of the plans for the United States Steel Corporation before going ahead, and sellers have postponed the announcement of prices for the same reason. Another week will probably bring the publication of the prices of Bessemer ores from the old ranges. Every week has strengthened the position of the ore men, there being added to the advance in prices of pig iron and steel the efforts of large interests to secure further ore properties. The purchases on the Mesabi range announced last week were in reality for the United States Steel Corporation, the Rockefeller mining interests being now practically arranged for by the Morgan syndicate. On the Menominee range the Aragon mine is reported under option to another constituent of the big combine, and there are evidences that negotiations have started looking to the purchase of the only considerable independent ore interest on the Marquette range. It is understood that in all the recent deals and tenders for iron mines the consideration proposed has been one calculated to tempt the seller, and this has by no means tended to lower ore values for 1901. Non-Bessemer ores, like the Mesabi product, will go on the market this year without agreement, in view of the independent action heretofore of a large miner of such ores. From $3 to $3.25 for the best of the Crystal Falls district ores is the basis discussed.

Vessel rates are still undetermined. Dock managers have been in conference with repreentatives of the longshoremen's union the past week. The men ask 15½ cents for unloading ore against 14 cents last year, and are attempting to limit the amount of ore to be handled by the latest unloading machines. The report of charters from the head of the lake at 50 cents, all dock charges to be borne by the shipper, cannot be confirmed. It is estimated that the new tonnage building for 1901 would mean an addition of 6,000,000 tons to the capacity of the lake fleet if operated a full season, though a good portion will not come out for several months.

PIG IRON.—Sales of several thousand tons of Bessemer pig iron were made in the week to a large interest that has not been a conspicuous buyer in the movement of the past two months. The price was $16 at Valley furnace, the deliveries being chiefly for April and May. It was said to be practically impossible to get Bessemer for April, and there is little available for shipment in May and June. Foundry iron continues to be in good demand for shipments running to July 1; little has been done in this market beyond that point apart from a few of the larger consumers. The weak sellers of the past month are less in evidence and $14 Valley furnace is minimum, with $14.25 asked in some cases for No. 2 iron. We quote $13.50 in the Valley for gray forge, and some Pittsburg sales have been made on a slightly higher basis. The furnace workers of the Valleys have called a meeting for March 22 to organize in support of a demand that wages be restored to the figures existing before the 10 per cent reduction of Feb. 1. We quote the Cleveland pig iron market as follows:

Bessemer	$16 75 to 17 25	Valley Scotch No. 1	$15 25 to $15 75
No. 1 Strong F'dry	15 25 to 15 75	Valley Scotch No. 2	14 75 to 15 00
No. 2 Strong F'dry	14 75 to 15 00	Gray forge, valley	13 50 to 13 75
No. 3 Foundry	14 25 to 14 50	LakeSuperior charc'l	17 50 to 18 00

FINISHED MATERIAL.—No large business has come to local sellers in the past week but the strong features of the situation continue, and on some products there are advances, notably on sheets which are $3 a ton higher for black. We quote No. 27 (one pass through cold rolls), at 3.25c, and No 28 at 3.35c at mill. A corresponding advance has been made in heavier gauges, both blue annealed and cold rolled. For the former we quote: No. 12, 2.10c to 2.15c; No. 14, 2.20c to 2.25c; No. 17, 2.40c; No. 18, 2.50c to 2.55c; No. 20 (one pass through cold rolls) 2.90c. The plate market shows no large business up, though vessel work will call for further tonnage in the near future. There is a steady demand from boiler and tank works and prices on ordinary lots are 1.50c to 1.60c Pittsburg for tank. For bars there is a steady demand and prices are firmly held. It is evident that considerable agricultural buying is yet to be done. All the mills are well filled for some months, in several instances past the middle of the year. Bar iron is sold at 1.45c Valley mill, half extras, and 1.5cc Cleveland in carload lots. Steel bars are quoted 1.45c to 1.50c Pittsburg, small lots bringing $1 to $2 a ton higher. Local conditions in the structural market are unchanged. Indications point to a congestion of mills later on when delayed specifications crowd in.

OLD MATERIAL.—Prices are firmer and some dealers are asking higher prices than consumers are ready to pay. We quote Cleveland prices as follows, all gross tons: Old iron rails, $18 to $19; steel rails, $15 to $15.50; 6 feet and under, $14 to $14.50; old car wheels, $16; No. 1 wrought scrap, $16 to $17; mill scrap, $13.50 to $14; No. 1 machinery cast scrap, $14 to $15; iron axles, $22 to $23; grate bars, $8 to $8.50; stove plate, $8.50.

PHILADELPHIA.

March 9

A comparison of the Western market with that of the East shows an inequality in conditions such as has not been witnessed for three or four months past. The Eastern market is not only monotonous but absolutely dull in some lines. There is great firmness in Western specialties, such as billets, but local products fail to advance in price.

PIG IRON.—Sales during the past week have been in large lots and at a lower figure than any recorded this year—No. 2 plain at $14, No. 2 X at $14.50, mill and low grade foundry irons at $13.25 to $13.75, deliveries chiefly to the Harrisburg and Lebanon districts. Western buyers have taken considerable quantities of basic iron, one being a 10,000-ton lot for Pittsburg. Large sales of mill and foundry irons have been made at surprisingly low prices, and yet the statistical conditions are highly favorable. This incongruity is difficult of explanation. It does not meet the case to say that the makers of pig iron failed to take advantage of the market when it was strong several weeks ago and now are trying to force sales, or that a reduction of 50 cents to a desirable class of buyers is a matter less serious than it appears. Average quotations are as follows: No. 1 foundry, standard brand, $16 to $16.25; No. 2 X foundry, standard brand, $15 to $15.50; No. 2 plain, $14.50 to $14.75; gray forge, standard brand, $14 to $14.50.

BILLETS.—Inquiries are numerous, but the market has already been overtaxed. The scarcity of steel is felt more and more and buyers will have considerable difficulty in securing early deliveries. The average price is $23, and in some cases $23.50 to $24 is asked for Bessemer steel.

FINISHED MATERIAL.—Plates are in great demand and will likely be during the spring and summer months—boiler shops, locomotive works, shipyards and bridge shops being well supplied with orders. Bars and structural material are comparatively dull and prices are practically unchanged. We quote: Plates, ¼-inch and thicker, 1.65c to 1.70c; iron bars, 1.40c to 1.50c; steel bars, 1.50c to 1.60c; angles, 3-inch and upward, 1.55c to 1.65c; beams and channels, 1.65c to 1.75c; sheets, Nos. 10-14, 2.20c to 2.30c; Nos. 18-20, 2.70c to 2.80c; Nos. 24-27, 2.90c to 3.00c; No. 28, 3.00c to 3.15c.

OLD MATERIAL.—Prices are firm at full quoted rates. Bids and offers, for deliveries in buyer's yards, appear as follows: Choice railroad scrap, $19 to $20; No. 1 yard scrap, $14 to $15; No. 2 light scrap, $12 to $12.50; machinery cast, $14.50 to $15; heavy steel scrap, $16 to $16.50; old iron rails, $19.50; old steel rails, $16 to $16.25; wrought turnings, $10.75 to $11.25; cast borings, $8 to $8.50; old car wheels, $17.50 to $18; old iron axles, $22 to $23.

BIRMINGHAM, ALA.

March 18.

The local iron market was marked last week by another advance of 25 cents a ton in the price, the fourth advance of that amount since November 7, the price now being $1 a ton higher than it was the first week in November and 75 cents higher than on January 1, of this year.

The inquiries for iron continue active though sales are not reported with such frequency as a month ago. Still a number of sales of considerable tonnage were made during the week. Officials of the furnace companies state that some buyers are urgent in asking early shipment of iron sold for delivery several weeks hence, and in some instances a slight advance is offered for such quick deliveries. In speaking of the condition of the iron market President Baxter of the Tennessee Coal, Iron & Railroad Company states that he sees no reason why the activity that now exists should not continue throughout the year. Local quotations now are: No. 1 foundry, $12.25; No. 1 soft, $12; No. 2 foundry and No. 2 soft, $11.50; No. 3 foundry, $11; No. 4 foundry, $10.50; gray forge, $10.25.

The new soaking pit of the Ensley steel mill of the Ensley plant of the Tennessee company has been put in operation and is working satisfactorily. Five of the ten furnaces at the mill are now in operation, their output last week being 600 tons daily, or over 4,000 tons for the week. The demand for this steel is very good, billets being quoted at $20.

The Alabama Iron Bedstead Co. has been incorporated with $20,000 capital stock. The company is building a plant at Ensley for the manufacture of iron bedsteads.

The Anniston Rolling Mill will be put in operation on March 25. This plant has recently passed into new hands. It was built several years ago, but has been idle since a short time after its completion.

It is stated that James Bowron, vice-president and treasurer of the Tennessee Coal, Iron & Railroad Company, will retire from the company at the meeting of the directors which will be held in New York in a few days. Edward Graves of New York, one of the newly elected directors, it is stated will succeed Mr. Bowron as treasurer and the office of treasurer will be removed from Birmingham to New York.

Local officials of the Tennessee and Sloss-Sheffield companies state that they have not been advised of any contemplated consolidation of these two companies with the Republic Iron & Steel Co. W. J. B.

Cumberland Light Rail Mill to Start Up.

The mills at Cumberland, Md., formerly operated by the Potomac Steel Co., in the manufacture of light steel rails will resume operations in about ten days under the management of the firm of Jos. Schonthal, scrap dealers, with offices in Pittsburg, Pa., and Columbus, O. A. F. Baumgarten, the junior member of the firm, will have charge of the sales and purchases at the Pittsburg office, 1221 and 1222 Park Bldg., and George Tatnal, well known as a superintendent and manager of mills, will be in charge at Cumberland. Mr. B. Schonthal will assist him in the direction of the office and affairs at Cumberland. These mills have been idle since September last. They will be started with a capacity of 100 tons per day, which will be rapidly increased, and the bar and muck mills will be put in repair and operation within a few months. The firm of Jos. Schonthal will be prepared to furnish 16, 20, 25, 30, 35, and 40-lb. steel rails and splices for prompt shipment and expect to supply the wants of the trade in this material through the Pittsburg office.

Advance in Rolling Mill Wages.

As a result of the bi-monthly wage adjustment of the bar iron workers of the Amalgamated Association of Iron & Steel Workers of America, the puddling rate for the months of March and April has been increased from $4.75 to $4.87½ a ton. The finishers secure an advance of 2 per cent also. This is the first advance received by the men since the new wage scale went into effect and owing to the advances in the price of iron bars during the past few weeks another advance is looked for in May. The sheet mill workers receive no advance in wages, as the sales sheets of the American Sheet Steel Co. show that the selling price of sheets for the past two months has been below the fixed base.

President T. J. Shaffer has issued a circular to all the sub-lodges of the association asking them to vote upon the establishment of a permanent board of arbitration and conciliation. Mr. Shaffer states that the establishment of such a board would eliminate many of the differences between employer and employe, as all questions relating to wages and hours of work would be referred to this board for adjustment.

Judging from the large number of suggestions received from the various sub-lodges of the Amalgamated Association of Iron, Steel & Tin Workers of America, for changes in the present wage scale to be presented at the annual convention which opens at Milwaukee on May 14, the workers are dissatisfied with their present wages and are clamoring for increases. The time for submitting suggestions closed Tuesday of this week and more were received than ever before. It is a certainty that higher wages will be asked for in all classes of mills. With reference to the non-interruption clause, the sub-lodges almost unanimously voted in favor of its embodiment in the scale provided a proper base can be agreed upon. Many suggestions were also made such as having both parties to the wage agreement giving 90 days' notice of an anticipated change. If a base should be decided upon for any number of years the annual wage disputes and shutting down of the mills during the summer months would be done away with entirely.

The Robert Aitchison Perforated Metal Co., of Chicago, is having an excellent run of business. The company has recently made shipments to Kentucky, Wisconsin, Utah, Nebraska and many other States. These cover material for railroads, agricultural implement works, breweries and other industries. Among recent inquiries are some from Australia, Germany and the West Indies.

Solon J. Vlasto, 2-4 Stone street, New York, makes a specialty of the importation of Styrian and Greek calcined magnesites, and deals also in manganese, chrome, emery, brimstone, pyrites, silica and iron ore. An analysis of the Vlasto Styrian magnesite shows the following: Magnesia, 91.902 per cent; carbonic acid, 0.300 per cent; ferric oxide, 4.121 per cent; salicic acid, 1.140 per cent; aluminum, 1.121 per cent, with traces of chalk and argillaceous earth. The average analyses of the Vlasto Greek magnesite from 40 steamer cargoes (123,560 tons), imported in the past seven years is as follows: Carbonate of magnesia, 95.83 per cent; magnesia other than carbonate, 0.89 per cent; silica, 0.39 per cent; oxide of iron, 0.36 per cent; alumina, 0.01 per cent; carbonate of lime, 1.71 per cent; organic matter and combined water, 0.67 per cent; moisture at 212 degrees F., 0.14 per cent.

The important metal mixer suit of the Carnegie Steel Co. against the Cambria Steel Co. has again been restored to the docket by the United States Supreme Court and further arguments will be heard as the court desires further light.

THE IRON TRADE REVIEW

Devoted to Machinery, Metal-Working and Foundry Trades and Iron and Steel Manufacture.

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A. I. FINDLEY, EDITOR.

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ENTERED AT THE POST OFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER

MARCH 21, 1901.

AN IRREPRESSIBLE ISSUE.

What labor union restriction of output comes to, in the engineering trades in England, is illustrated in a case cited as an every-day possibility in machine shops there. The foreman in question is a member of the Amalgamated Society of Engineers. A walking delegate or other headquarters official comes to him with the message, "We have — members unemployed; can't you find work for them?" The reply may be, "Well, I have as many men as I want," in which case the order is quite sure to be, "Put on another man and let them work a little slower."

The writer who cites the above refers to it as typical of the condition in union-controlled shops on the other side. No one claims for a moment that American machinery manufacturers can keep on passing foreign makers, in the great international race, if the object openly avowed by English trades unions, that of keeping the largest possible number of men employed and making the work go as far around as it will, is made prominent here. Yet that the policy of organizations having to do with the metal working industries in the United States borders close upon the discredited and defeated attempts of the English engineers is palpable enough to cause serious thinking. Opposition to machinery and piece-work, limitation of the output of the individual, and limitation of the output of a plant, as provided in tin-plate wage scales for example, are manifestations of the spirit that would establish labor cost by decree.

We believe this matter is by far the most important with which American manufacturers, and particularly machinery manufacturers, have to deal today. It is a serious question, as indicated in a communication in another column, whether the positions of organized employers and organized employes on this issue are not so divergent that conferences and conciliation will not be as effective as on some other issues. The mission of the machine and the legitimate mission of the union are not essentially antagonistic, and a plan for increasing output and wages as well, through the premium piece-price method, is on the face of it desirable. Yet in the case of the International Association of Machinists, the antagonism to piece-work has been embodied in the organic law of the union. There has been an apparent modification of this position in the New York agreement, as pointed out in the communication of the Christensen Engineering Co., yet when the issue came up squarely the agreement was as weak as sand.

As we have said repeatedly, the attempt to make product more costly is contrary to the whole trend of invention and of industrial progress. It cripples the producer and narrows his market and thus can only do injury to his employes, whom it is supposed to help. It is to be hoped the folly of the anti-piece-work crusade will be seen by its promoters, in the history of British industry, and that the repetition of that costly object lesson may not be required in the United States.

RAILROAD EXPANSION IN THE NEAR FUTURE.

With orders for more than 1,800,000 tons on their books the rail mills are not in doubt as to the character of this year's business either in volume or profit. The *Railway Age*, in connection with the statement that full returns show 4,436 miles of new steam lines added in the United States in 1900, gives an estimate concerning the present year. A list of 200 railways now under construction or under contract accounts for a mileage of 5,908, and "live projects" calling for 2,294, would increase the total to 8,202 miles upon which work may be completed or begun in 1901. The Southwestern States contribute 2,059 miles of the 5,908 miles of lines under construction, and the South Atlantic States, 1,172 miles. The Southwest, including 763 miles in Texas and 612 miles in Oklahoma and Indian Territory, is the section of greatest promise in the direction of railroad development. The New England States show but 38 miles of railroad under contract or under construction, indicating that the construction of steam railroads has almost ceased. But our contemporary refers to the continuance of competitive track laying in these and other thickly peopled States, electric railway projects and electric railways in operation being plentiful in all the older States. The trolley lines connecting thriving towns in Eastern and Central Western States have done much to lessen the building of local lines of steam railway, and they promise to be increasingly influential in retarding such development. The Southwest will continue to be the field of the largest possibilities for steam lines.

The *Railway Age* makes some observations on two prime features of railway construction from this time on, that are of special significance to the iron trade:

> Two notable changes in the principles and motives of railway construction are evidently to characterize the new century. First, the era of parallel and competitive road building has ended, and rival companies will not hereafter push madly into each other's territory, duplicating tracks where one is sufficient and piling up bonded debts only to have them wiped out by foreclosure. Co-operation, or at least reasonable and honest competition, is to take the place of reckless overbuilding and disreputable rate-cutting, and roads will be built because they promise a fair return and will benefit all concerned, and not because some other line has built or may possibly build into that locality. With these principles in operation in railway building, contractors and supply dealers will get their pay, bond-holders will receive their promised interest, and stockholders will have a reasonable assurance of dividends. It will be the golden era of railway expansion.
>
> Second, it is to be notable as the era of physical reconstruc-

tion. Within the last year some of the great railway companies have expended many millions in reducing grades, straightening curves, replacing wooden structures with steel and stone, multiplying tracks, building new stations and otherwise substituting the permanent for the primitive, and this work has only begun. The standard of construction and equipment of American railways in 1901 is vastly higher than it was in 1887, for instance, when 13,000 miles of track were thrown down and called completed. New road is now being built well and old road is being rebuilt better, and every mile of line hereafter will be equivalent in labor and value to several miles hurriedly put together in the days of quick construction and rapid bankruptcy, now, it is to be hoped, happily ended. The railway builders and supply men will have much to do and to sell in the coming years, and railway building, equipping and managing will stand on a more satisfactory basis than in the past century.

Rockefeller Mines and Vessels Included.

The report has reappeared in the past week and has been confirmed by J. P. Morgan & Co., that the Lake Superior Consolidated Iron Mines and the Rockefeller railroad and vessel interests are to be taken into the United States Steel Corporation. No official announcement has been made, however, of the terms or of the actual closing of the deal. Mr. Rockefeller's interests include the Lake Superior Consolidated Iron Mines, with a capital stock of $50,000,000, of which $29,887,448.97 is outstanding. It was incorporated under the laws of New Jersey in 1893 to acquire and operate iron mines on the Mesabi range, Minnesota. The company owns extensive properties in this region, and leases some of its mines to the Oliver Iron Mining Co. and others. It owns the Duluth, Missabe & Northern railway, extending from Duluth to Mountain Iron, Minn., and embracing about 130 miles of road. The Lake Superior Consolidated Iron Mines has no direct mortgage indebtedness of its own but the Duluth, Missabe & Northern railway has a bonded debt consisting of $1,100,000 first mortgage 6 per cent bonds due in 1922; $2,251,000 consolidated mortgage 6 per cent bonds due in 1923, and $2,644,000 second mortgage 5 per cent bonds due in 1918. The stock of the Lake Superior Consolidated Iron Mines sold a few years ago as low as $9 a share. In the past week sales have been made in Boston at 104 and in New York on Monday 120 was reached.

The Rockefeller vessels are operated under the corporate name of the Bessemer Steamship Co. Including the whaleback fleet there is a total of 56. The properties of the Lake Superior Consolidated Iron Mines are the Adams, Spruce and Cloquet at Eveleth; the Hull, Burt, Rust, Sellers and Pillsbury in the Hibbing district; the Duluth, at Biwabik; the Etna at Mountain Iron; and the Minnewas at Virginia. In addition the company has vast reserves that together with the active properties represent nearly half the iron ore on the Mesabi range.

The National Metal Trades Association.

Announcement is made by Secretary Henry F. Devens of the third annual convention of the National Metal Trades Association, to be held at the Hotel Cadillac, Detroit, on Tuesday and Wednesday, April 9 and 10. The association through its secretary has been bringing its work to the attention of manufacturers in the metal-working trades in the past year, urging machinery manufacturers to become more closely united in view of the strong union maintained among their employers. While the membership of the association includes many strong firms, others are yet to be induced to join, and a number of the latter have been invited to attend the Detroit convention. The association made a joint agreement with the International Association of Machinists in May last, with which instrument our readers are generally familiar, and though it has not ended all friction it has been in many instances the means of avoiding serious trouble in the works of members of the assocation. On April 1, an agreement will be presented to all machinery manufacturers in the United States and Canada, not members of the association, by the International Association of Machinists, accompanied by a letter from the local lodge, requesting an early reply. The International Association of Machinists is conducting a most vigorous campaign for the inauguration of a shorter working day without a decrease in the daily wage, and in which it has the pledged support of the American Federation of Labor.

The right of employers to introduce shop methods which are in the line of economical production, and their right to hire and discharge employes, are representative questions which it is believed can be better handled through organization than through individual effort. What the association has done and what it purposes will be pointed out, and other information furnished by the secretary, in response to any letter addressed to him at 95 Liberty St., New York.

Late Pittsburg News.

(Special Telegram.)

PITTSBURG, March 20.—William G. Park chairman of the executive committee of the Crucible Steel Co. of America, resigned at a meeting of the committee at New York on Monday. He retires to get away from business cares. His successor has not been elected.

The Sharon Steel Co. has decided to increase the capacity of its mills from 250 tons to 400 tons daily, also to engage in the manufacture of boiler tubes on an extensive scale.

Personal.

W. Y. Williams succeeds D. D. Lewis as superintendent of the Bessemer department of the Lorain Steel Co. at Lorain, O., Mr. Lewis having taken charge on March 15 of the Lake Superior Power Co.'s steel plant now under construction at Sault Ste. Marie, Ont. The employes of the department presented Mr. Lewis with a diamond pin.

Col. Millard Hunsiker, European representative of the Carnegie Co., was in Pittsburg several days last week. On April 1 he will sail on the Kaiser Wilhelm der Grosse.

J. P. McCaslin, night superintendent of the upper plant of the American Steel Hoop Co., at Youngstown, O., has been appointed superintendent of the plant recently acquired by the company at Atlanta, Ga.

Lake Superior Iron Mines.

Announcement is made of the sale of the properties of the Odanah Mining Co., the Carey and Superior mines, located west of Hurley, Wis., to Pickands, Mather & Co., of Cleveland. These mines have been operated about two years, producing last year 140,000 tons of ore, which may reach 175,000 tons this year.

The Pewabic Co., Iron Mountain, Mich., has placed an order with the Fred M. Prescott Steam Pump Works of Milwaukee for a new pumping plant for the Walpole mine. The plant will have a capacity for handling 1,000 gallons of water per minute, from a depth of 800 feet.

Obituary.

Samuel J. Reeves of Canal Dover, O., treasurer of the Reeves Iron Co., whose sheet mill plant was absorbed by the American Sheet Steel Co., died on March 15, of typhoid fever, aged 30. Mr. Reeves was one of the best known iron manufacturers of the Central West and though he had scarcely more than entered upon his career was credited with unusual ability.

John Feigel, Sr., a member of the manufacturing firm of W. H. Larkin & Co., died at his home at Butler, Pa., Thursday, March 14. He was born in Berlin, Germany, 57 years ago. Fifteen years ago he located at Butler and associated himself with W. H. Larkin and established an extensive oil well supply manufacturing plant.

The Jas. H. Baker Mfg. Co., of 503 Park Bldg., Pittsburg, has completed a steel extension to its works at Tarentum, Pa. An additional engine has been installed, the boiler capacity increased and considerable equipment added, including eight hammers, four of which are heavy steam drop hammers. Punching presses have been added, to balance the additions to forging capacity. The company reports demand good particularly for railroad forgings and for special work. In the latter the company has large contracts for articles requiring special attention and development. The plant has been running 22 hours a day since November.

The S. Obermayer Co. of Chicago and Cincinnati, has been appointed sole Western sales agent for the Hanna portable pneumatic screen shaker. The device is having a large sale and the S. Obermayer Co. reports inquiries already in hand from all parts of the country.

NEW ENGLAND FOUNDRYMEN'S ASSOCIATION.

The monthly meeting of the New England Foundrymen's Association was held at Boston, Mass., on Wednesday, March 13. At the session in the afternoon an address on "Cupola Construction and Management" was presented by Thos. D. West, accompanied by a number of charts, which were commented upon by the speaker. A synopsis of the address is given elsewhere. This session was very interesting and profitable, lasting until 5:30. Then followed an informal half hour and at 6 o'clock dinner was served, covers being laid for 49 persons, all but two of whom were foundrymen. The evening session for the discussion of foundry topics began at about 8:30 and lasted until 10:30. It was chiefly an informal quiz, Mr. West being kept on his feet most of the time answering questions, which in turn provoked lively discussion. Mr. West made some comments at the outset on latter-day methods of mixing iron. He referred to the practice of choosing iron by fracture as having been handed down from those who first made use of appliances to remelt cast iron. This was done first in crucibles and later in calabashes, which are similar to cupolas but movable. They were used as far back as 1734. Mr. West stated that over half of the founders of the country are now working by analysis in making mixtures and these could by no means be persuaded to return to the old method. It is true that some have tried to work by analyses and failed. This is not the fault of the science of chemistry. Simply accepting a furnace analysis of pig iron and trying to be guided by it will not make a founder successful in the use of chemical analyses. There are many things to be considered and carefully guarded against, in order to make this practice a success. No founder who worked by fracture could show such records for regularity in results as were attained by those using analysis. The speaker combated the idea that the hardness of pig iron could be a guide to the character of the castings it would produce. He urged the foundrymen present to do all in their power to advance the practice of employing chemistry for the making of mixtures.

The meeting was presided over by President George B. Buckingham, Fred F. Stockwell, secretary. The following firms were represented: Arcade Malleable Iron Co., Barbour-Stockwell Co., A. Carpenter & Sons Foundry Co., Condor Iron Foundry Co., Rufus K. Jordan, Kinsley Iron & Machine Co., H. B. Smith Co., Fred W. Dixon, Taunton Locomotive Mfg. Co., City Iron Foundry, Pawtucket Foundry Co., W. B. Grant, Phoenix Iron Foundry Co., American Tool & Machine Co., Allston Foundry Co., James Hunter Machine Co., Pratt & Whitney, Hayes Foundry Co., Geo. H. Lincoln & Co., A. W. Bond & Co., Whiting Foundry Equipment Co., Wollaston Foundry Co., Rogers, Brown & Co., Weir Stove Co., Walker & Pratt Mfg. Co., Bellows Falls Machine Co., Hopson & Chapin Mfg. Co., Kables Foundry Co., Saco & Pettee Machine Shops, International Power Co., Colvin Foundry Co., New England Butt Co., H. E. Pridmore, Brown & Sharpe Mfg. Co.

A vote of thanks was given Mr. West for his paper and for his willing response to all the questions asked by his auditors.

Vulcanus Forging Co.

In view of their rapidly increasing business, the directors of the Vulcanus Forging Co., of Cleveland, at their last monthly meeting decided to increase their capital stock from $50,000 to $100,000. It is intended to make many improvements and enlargements to the plant of the company, which will be of considerable cost. Plans for the construction of new buildings on the unoccupied part of the company's property, at the corner of Hamilton and Wason streets, are being prepared, and by mid-summer it is expected that new machine shops and a new power plant will be ready for use. An expenditure of $30,000 will be made for new machinery, the purpose being to have the equipment of the plant thoroughly modern.

The Vulcanus Forging Co. was incorporated March 22, 1899, with a capital stock of $20,000. Within a few months this was increased to $50,000. A fire at the plant in May, 1899, delayed operations somewhat, and in October of the same year a second fire which burned to the ground all the plant but the power house, found the company with contracts on hand amounting to over $25,000, but this was advantageously sublet. The plant was rebuilt and went into operation in February, 1900. It consists of a forging and machine shop, 127x125 feet in dimensions, and a power plant 50x75 feet. The company owns property on Hamilton street, between Wason street and Case avenue, with a frontage of 140 feet, and a depth of 250 feet running back to Dart street. On the rear of the property are direct switches from the Pennsylvania railway. Several large upsetting and rivet machines, and a large 4¼ inch Reliance machine and tool threader will be added to the equipment at once. Throughout the past year orders on the books at a given time have ranged from $15,000 to $30,000 worth, and at present the business in hand and the outlook are most gratifying. The products of the company consist of all kinds of structural and boiler rivets and bolts, rods, telephone specialties, special nuts, air brake pins, lag screws, machinery forgings and special forgings. The company holds patents which have been a source of great profit. Chief of these is a patent Hathaway transfer table, which has a sale all over the world.

The officers of the company are as follows: President, F. J. Patterson; vice-president, Henry J. G. Melcher; treasurer, J. A. Melcher; manager, A. G. Hathaway. The directors are the foregoing officers and Charles Hathaway, Frederic Zimmerman, W. B. Maxson, and H. St. Clair Hathaway.

Splendid Gifts from Andrew Carnegie.

Mr. Andrew Carnegie has made the past week memorable in the record of his princely bestowments. Just before sailing for Europe on Wednesday, March 13, he wrote a letter to President Schwab and the managers of the Carnegie Co., turning over to them $5,000,000, of which $1,000,000 goes to the maintenance of the Braddock, Homestead and Duquesne libraries previously built through his generosity, and $4,000,000 for a pension fund, the income of which is to be used for the relief of sick or needy employes of the Carnegie Co., or for the relief of families of men killed in accidents in the company's works. Another surprise came in the announcement in the same week of Mr. Carnegie's offer of $5,200,000 for the establishment of 65 branch libraries in New York City provided the city furnishes sites and maintains the libraries. Several citizens of New York have already offered sites and the city officials expect to comply with the conditions so that the entire gift may be secured.

In connection with his Pittsburg gift Mr. Carnegie wrote a letter to his associates telling of his plan for the pension fund. He also addressed a letter to his friends in Pittsburg giving his reasons for retiring from active business. These letters have been widely published in the week. They reveal anew the generous impulses and the rare philosophy of the writer. We regret that the demands upon our space forbid the carrying out of our wish to publish them as a matter of record.

Five interesting blue print charts have been prepared by R. G. Beker, Ohio Engineering Co., Cleveland, from the statistics of the American Iron and Steel Association and others. The first is a plot of the total pig iron production of the United States for 1810-1900. In comparison with it the production of Great Britain for 1850-'99 is shown. In addition the total charcoal pig production, and the Bessemer pig production of this county from the beginning to 1899 are given. The production of Alabama, Illinois, Ohio, and Pennsylvania for 1895-'99 are likewise plotted, with prices of pig iron for the different years in the United States. A second chart treats particularly of the production of steel rails. The third chart plots the steel production of the United States and other countries from 1872 to 1899. As in other products, the graphic presentation emphasizes the position of the United States, the output for 1899 reaching over 10,000,000 tons, Germany following with over 6,000,000 tons, while Great Britain is third with 5,000,000 tons. Coal production in the United States from 1885, with a comparison of the outputs of different counties in 1898 and 1899, is the subject of the fourth chart. The fifth is devoted to iron ore production in the United States from 1884 to 1899 inclusive, with special lines for the Lake Superior ranges. The world's production of iron ore for 1899 or the latest year of official returns, is shown in the form of banded columns. The pre-eminence of the United States in iron and steel and coal is strikingly shown by the entire series.

BLAST FURNACE AND STEEL WORKS CHEMISTRY.

Practice at the Duquesne Steel Works.

To the Editor:

I think it can be safely said that good chemists recognize two sorts of silicon determinations, the "hurry-up" and the regular kind. Among the former are all those in which, without waiting for complete solution of the drillings, the solution is rapidly boiled to dryness over a Bunsen burner or blast lamp, and then rapid solution of the resultant residue and filtration. The methods are all subject to three sources of error other than those of ordinary manipulation: 1. Incomplete solution of the sample, thereby contaminating the silica with metallic iron. 2. Loss by spattering. 3. Incomplete solution of the final salts, contaminating the silica with the oxides of iron. By the exercise of rare good judgment rarely found in a "good" chemist, these three sources of error may be made to balance each other and a correct result found, but at best the method is only a makeshift one. As first proposed by Mr. S. A. Ford it was for the purpose of determining the silicon in the mixer iron after the addition of a cast to the mixer and before the mixer iron would reach the converting mill, with the idea of guiding the blower in the scrap additions to control the heat in the converter. It was afterwards found that the data so obtained were of no use to the blower, he being perfectly able to regulate the temperature during the blow by scrapping, steaming or side blowing. The silicon determinations are still continued, but more carefully, and merely as a case of back reference.

An accurate determination of silicon with the minimum of error means the complete solution of the drillings, the evaporation to dryness without boiling or spattering, and then baking or drying to complete dehydration of the silicon, complete solution of all the resultant mass but the silica and carbon (if not previously destroyed), filtration and washing, leaving nothing but the silica and carbon on the filter, burning and weighing. Our average time for shot samples, taking twice the factor weight, is forty-five minutes, while any number up to six can readily be done in an hour.

Previous to the construction of furnaces at the plant with which the writer is connected, we were buyers of pig iron and the receipts ranged from 100 to 150 cars per day. Aside from other elements a silicon determination was made in a sample pig from each car before unloading. With 40 silicon dishes and a hood containing 20 burners and tripods and an equal number of funnels, filtering flasks and platinum crucibles, and burning the precipitates 20 at a time in a muffle furnace, two men could readily complete the 150 silicon determinations in nine hours.

J. M. Camp.

Duquesne, Pa., March 16, 1901.

Five Determinations in an Hour.

To the Editor:

In answer to the inquiry in regard to silicon determinations: Part of the regular work of our laboratory (Ashland Iron & Steel Co.) consists in making five silicon determinations on samples from different beds on each cast of iron. These five determinations are regularly made in one hour from the time the sample pigs are received. This includes drilling the samples on a hand drill press. The evaporations are made in No. 1 beakers on an ordinary hot plate, with nitric and sulphuric acid, no chromic acid being used. The ignitions are made in platinum crucibles over gasoline burners, which are not nearly as good as a gas blast lamp. In a laboratory supplied with gas and a blast the time for the five determinations could undoubtedly be reduced to fifty minutes.

Eugene B. Smith.

Ashland, Wis., March 14, 1901.

What Is Done at Another Canadian Furnace.

To The Editor:

Referring to the article which appeared in a recent issue of *The Iron Trade Review* relative to the rapidity of silicon determinations: I notice that our friend, Mr. Holland, has asked a comparison of his record with that of chemists in the United States. With your permission, however, I beg leave to offer a few notes and figures from my experience as chemist at another Canadian charcoal furnace. It has already been very rightly stated by Mr. F. W. Bauer in his communication under date of Feb. 16 that second in importance to the method itself, the length of time required for a silicon determination depends very largely indeed upon the "laboratory equipment, and upon other conditions." Of the other conditions the most important is, first, the silicon contents of the sample under analysis and second, the proportionate amount of graphitic carbon present. Below is given a record of the length of time required by the writer in determining the silicon by Drown's method in our No. 2 charcoal iron, varying from 0.90 to 1.50 per cent in silicon and from 1.00 to 2.00 per cent graphite.

One determination was made in 18 minutes.

Two determinations were made in 24 minutes.

Three determinations were made in 31 minutes.

Four determinations were made in 40 minutes.

Six determinations were made in 55 minutes.

I am in the habit of dissolving and carrying on evaporation over Bunsen burners, and as quickly as the proper point of evaporation is reached, remove the dish and place immediately over a blast lamp, where from a blast of cold air directed against the bottom of the dish it is cooled in a very short time. Filtering is rapidly done through a 9 c. m. S. & S. filter, No. 589, by the aid of a filter pump which is so arranged that two filtrations are carried on at the same time.

Apart from the selection of good methods for use in the laboratory it has been the experience of the writer that it is not only necessary to be supplied with suitable apparatus in analytical work, which of course is the first and most important factor, but it is also important that in order to economize time in rapid determinations the apparatus must be so conveniently arranged that as little time as possible is lost in chasing about the labratory. For example, with the balances located in one corner of the building, the hood in another, the filter pump in a third, and the blast lamps in a fourth, a very good share of time must necessarily be lost in passing to and fro between these places during operations. It is therefore of importance that great care should be exercised by the chemist in so arranging his labratory apparatus that his labor and attention may be wholly concentrated on the determination in hand. More particularly will this be found advantageous when several determinations are being carried on at the same time.

Horace C. Mabee.

Deseronto, Ont., March 11, 1901.

Ten to Twelve Minutes the Limit of Speed.

To the Editor:

In response to Mr. Holland's request, will say that we make all our pig iron silicon determinations in 25 to 30 minutes, without suction, and burn off the graphite with an ordinary blast lamp. We can make them in less time, but I consider shorter time than the above dangerous for general laboratory work. Usually the samples are not uniform; one part of the sample dissolves sooner than others. But to run against time an experienced chemist can make a determination of silicon on an ordinary pig iron in 15 minutes without suction and burn the graphite off with an ordinary blast lamp without oxygen. By taking a specially prepared sample, using a platinum dish and evaporating to dryness with just enough solution to dissolve it in a hot flame without a watch glass (experience enabled me to make a solution that would not spit with a strong heat), redissolving as soon as dry, filtering, washing, igniting, weighing, experienced chemists cannot get a silicon through in less than 10 to 12 minutes, with all the arrangements of the times for rapid silicon determination, or if they can I never read of it.

C. Jones.

Laboratory Bellaire Works, National Steel Co.

Bellaire, O., March 14, 1901.

A Record of 6 1-2 Minutes.

To the Editor:

Replying to your inquiry in regard to a rapid silicon determination, will say that the best record made at the South Works for one determination was 6½ minutes. Conditions were purposely made favorable, and the 6½ minutes includes the time from starting to weigh to the time included in the final weight. It was made on iron carrying 1.50 per cent silicon. The average time for making one silicon determination is about 12 minutes. We frequently make two determinations in 15 minutes.

William Brady,

Chief Chemist, Illinois Steel Co.

South Chicago, Ill., March 15, 1901.

MODERN CONSTRUCTION AND MANAGEMENT OF CUPOLAS.*

BY THOS. D. WEST.

The subject which I have chosen for this paper is one in which every foundryman, no matter what his specialty, should be interested. All founders possess more or less knowledge of cupolas and mixing irons. It is not a great many years since some would have us believe that the science of operating cupolas was vested in good and evil spirits, who could be brought into control according as the cupola man puckered his mouth and the wind blew; and woe be to him who dared to intimate that they were appliances which could be controlled by human intelligence. Progress has so changed all this that if success is not achieved, a cause and a remedy are sought for by the use of brains in applying the principles which underlie all such work. The better we understand these principles, the more capable are we to attain success in the management of cupolas.

A great many different designs of cupolas have been used. Europe without doubt has tried a greater number than America. I could spend the whole afternoon sketching and explaining the different kinds of cupolas that have been used. This would be of interest had they been a success. Nevertheless, to know the reason why any certain appliances have been set aside may often better emphasize the features which were found an improvement over the old.

There was a time within the memory of many when the McKenzie cupola was largely used. This, as some present will no doubt know, was brought in at the tuyeres, which were continuous. This contraction made the tuyere section much smaller than any other part of the cupola. These cupolas worked well for small heats, or those of one or two hours' duration. When running longer than this the area facing the tuyeres became chilled and bunged up readily, so that the blast could not enter in sufficient volume to support the combustion necessary to do good melting, and besides the cupola was often bunged up so badly as not only to stop all melting, but cause much extra expense to clean out ready for another heat.

The gradual enlargement of heats which founders have found necessary to supply the growing demand for castings and meet competition, has led to a study of the cupola question and resulted in gradual enlargement of the area fronting the tuyeres. These changes showed such improvement that it is rare today to find any using other than what may be called straight cupolas, it being understood that the melting zone will be larger than the portions below or above it. It may be that in very large cupolas or those more than 60 inches inside diameter they may be brought in slightly at the tuyeres with good results, in some cases. Instead of doing this with large cupolas, I prefer to use center blast, which we have had in use at our foundry for about six years, running heats from 60 to 100 tons. I claim to be the originator of the first practical center blast, and why it has proved so successful in our foundry and is not more generally used will, I think, interest those present. (Chart shown with details.)

Another improvement that has been made in the past few years lies in the increase of the height of cupolas. Twelve to fifteen years ago if a charging door was six to nine feet above the tuyeres it was thought ample. It has been found very economical to increase the height of cupolas, as by so doing more heat is utilized in raising the temperature of the iron before it settles to the melting point. The Carnegie company has cupolas about 30 feet high to the charging portion. For long heats this is very desirable. Where heats are of only an hour or two duration it is not so practical. Heights of twenty feet upward, could be better utilized for light heats by having two charging doors and stagings. However, in heats ranging from one to three hours, the charging doors as a rule should be three and a half times as high above the bottom plate as the inside diameter of the cupola. Then again it is well to have a good height of stack and these are best built of the same diameter as the cupola. This plan gives the gases a better release and causes less destruction of the lining, besides making it more comfortable for men charging the stock.

The next question we will take up is the height and size of tuyeres. These are placed in cupolas all the way from 8 inches to 60 inches above the bottom plate and there are few things about a foundry so poorly designed for their work. One can find founders running very light heats for the capacity of their cupolas, having tuyeres from 20 to 30 inches high, while others are trying to run very heavy heats with tuyeres 8 to 12 inches high. I know there are those who advocate low tuyeres for all classes of castings or heats. I cannot believe that such persons have had any extended experience in running what are generally termed heavy work shop cupolas. I would like to watch a person trying to keep a low-tuyere cupola going for a whole day or week, as is often done with those having high tuyeres. Some founders think they have done well if they have run their cupola for two hours, and then have a clean bottom drop. The secret of being able to run long heats and have a clean drop lies in having tuyeres so high that they can not only hold what iron is necessary for a tap and which for some may range from one to ten tons, but also have a distance of 6 inches to 16 inches between the slag hole and the bottom of the tuyeres. This prevents the slag from approaching the level of the tuyeres sufficiently close to be cooled or chilled by the entrance of the cold blast, so that the slag can be kept in a very fluid state to flow freely out of the slag hole. By having a thin slag, the refuse which comes from the ash of the fuel, sand and rust of the iron, also the oxidation of the silicon and manganese, is prevented from accumulating in the cupola. Where this is accomplished and there is ample tuyere area, one may run cupolas over 30 inches inside diameter about as long as the lining will stand from being greatly impaired or burned out, and still have a clean bottom drop.

Where heats do not extend more than one to two hours, according to the size of the cupola, and the metal can be let run or tapped out at short intervals, it is not generally necessary to have tuyeres more than 12 to 18 inches above the bottom plate, and still have a clean bottom drop. Such low tuyeres for light heats save fuel and give hotter iron than high tuyeres. This is owing to the metal having to drop through less space to be cooled by temperature lower than that at the melting point. When cupolas from 24 to 60 inches or larger on the inside diameter have heats exceeding one to two hours' duration, it is generally necessary that they be designed to permit being slagged out, and in doing this, the greater space that can be left between the slag hole and tuyeres the cleaner and longer melting can be obtained.

The combined area of tuyeres should be about 25 per cent of the inside area of the average diameter. Up to about fifteen years ago tuyeres area were, as a rule, too small for good work. There are a great many different forms of tuyeres, but founders have come to learn that it is not so much the form as it is having sufficient area evenly distributed. Some founders use upper tuyeres in the distribution of blast. These are very effective in saving fuel, increasing the speed of melting and assisting cupolas to run long heats. Their drawback lies in shortening the life of linings. On account of this some will not use them. Their saving of fuel is due to their admitting a supply of oxygen above the level of the bottom tuyeres, to unite with escaping carbonic oxide which is a dead gas, and turn it more to carbonic acid, which is the form of gas obtained by thorough combustion. The truth of this is often exhibited where a flame can be seen started at the charging door or top of the stack by reason of a new supply of oxygen coming in contact with the carbonic oxide which is escaping out of the cupola. As there are those who do not believe there is any advantage gained by upper tuyeres, I will cite some experiments I made some years back that demonstrated their utility to me.

In regard to the volume of blast, it can be said that all should be used that is practical for creating rapid combustion. Large tuyere area and strong blast gives the greater speed and economical melting, as a rule. Too much blast is evidenced by a decrease in speed, clogging of the cupola and increase in fuel. It requires for best results from 30,000 to 33,000 cubic feet or something like a ton and a quarter of air to melt one ton of iron.

* Synopsis of a paper read before the New England Foundrymen's Association, Boston, Mass., March 13, 1901. The paper was accompanied by charts which were explained at length.

The variation of moisture in the blast has much to do with causing irregularities so largely found in melting. This can be realized more fully when we consider that oxygen free in the air forms about one-fifth by volume or one-fourth by weight, the other ingredient being nitrogen, in contrast with moisture or water, which in weight is 88.9 of oxygen and 11.1 of hydrogen. Air can absorb a large quantity of water. In warm weather it contains a great deal more moisture than in cold weather. At ordinary temperatures, air can contain about 0.27 per cent of water, whereas at zero it can hold only about 0.04 per cent.

The effect of moisture in the air is well demonstrated in making iron at blast furnaces. In the months of June, July and August the extra moisture in the air may call for about a third more fuel and reduce the output about one-fourth from that which can be obtained in cold weather. Water containing as it does 88.9 of oxygen, one might think it would serve the same end as oxygen in the air. Were it not for the fact that water resists dissociation of its elements up to a temperature of 1,800 degrees Fahr. it would not be so injurious in blast. However, before the blast is raised to a temperature of 1,800 degrees, which separates the hydrogen and oxygen of moisture, the latter absorbs much heat which means extra fuel.

It is generally conceded that no two heats in the same cupola will give like fluidity in the general management of cupolas. A study of the variations in the humidity and temperature of the atmosphere makes it possible to account for much of the irregularity noticeable in cupola practice and opens a field for the use of the hygrometer and thermometer, by any who desire the better to control the evils of daily changes in the temperature and humidity of the blast.

A MODERN AIR COMPRESSOR WORKS.

The plant of the Franklin Air Compressor Co., Franklin, Pa., in which manufacturing operations were begun in February, presents not a few features of interest, inasmuch as the aim of the builders was to secure an establishment thoroughly up to date in architecture and equipment. For the accompanying illustrations and description we are indebted to the *Railway Age* of Chicago, Ill.:

A general feature of importance in connection with the establishment, in addition to the fact that its owners will be in position to furnish complete air equipments from compressor to the smallest pneumatic tool, is that the compressors manufactured in the new plant will be of a kind especially adapted to furnish power for pneumatic tools and will be limited to their requirements. The working out of the problem is expected to result in settling upon a minimum number of styles which may be built in quantity with the advantages in the line of expense and uniformity which will be a natural outcome of this form of specialization. The Franklin Air Compressor Co. is capitalized at $300,000, and its officers are as follows: President, Charles Miller, president of the Galena Oil Co., and other concerns; vice-president, J. W. Duntley, of the Chicago Pneumatic Tool Co.; J. S. Coffin, assistant to the president, and Samuel G. Allen, secretary and general manager. The Franklin company will have to do with the manufacturing of compressors only. The handling of matters relating to sales will be controlled by a second company with offices in New York, and known as the New York and Franklin Air Compressor Companies. Of the latter organiza-

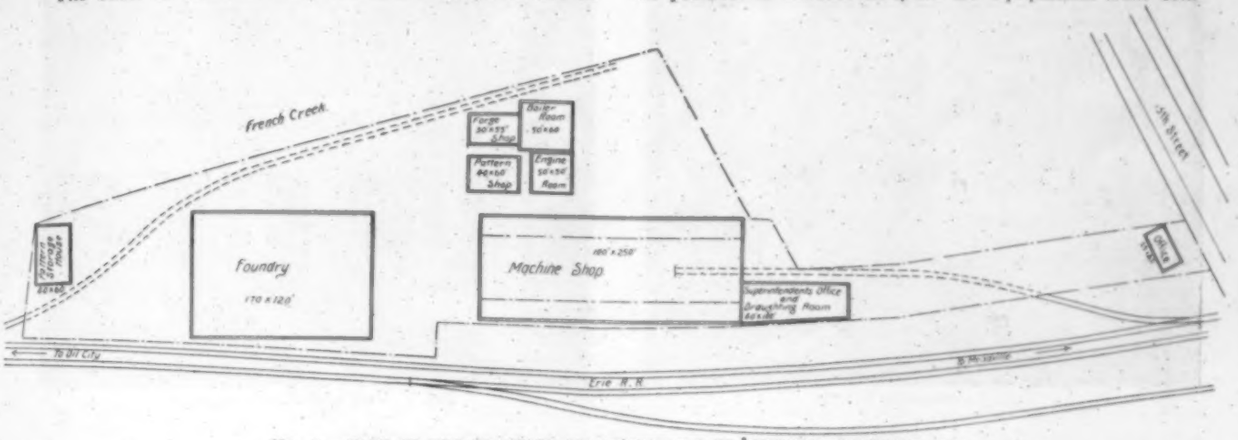


FIG. 1.—PLAN OF THE FRANKLIN AIR COMPRESSOR CO.'S WORKS FRANKLIN, PA.

FIG. 2.—MACHINE SHOP WITH PNEUMATIC TRAVELING CRANE.

tion, J. W. Duntley is president; Alexander Mackay, vice-president, and W. P. Pressinger, secretary and manager.

The new plant at Franklin has been arranged and equipped with the idea of making it modern in every respect. The general arrangement is shown in the accompanying plan. The principal buildings inclu e a machine shop, 100 by 250 feet, with superintendent's office and draughting room in an annex, 40 by 100 feet; a foundry, 120 by 170 feet, which is not yet completed; pattern storage house, 40 by 60 feet; boiler room, 50 by 60 feet; engine room, 50 by 50 feet; forge shop, 30 by 55 feet; pattern shop, 40 by 60 feet, and a two-story office building, 25 by 40 feet, at the entrance to the grounds. The site is directly on the line of the Erie Railroad branch from Meadville to Oil City, and in connection by switching lines with the other roads entering Franklin. The foundry building lacks the erection of its walls to be complete. The frame is fully erected. The other buildings are complete and fully equipped, and operations are under way for the filling of an order for 39 compressors. The interior of the machine shop, the principal part of the plant, is well shown in one of the accompanying engravings. The excellent provision in the way of lighting by natural light is shown with sufficient clearness and the equipment for electric lighting is satisfactory. The light effect is also enhanced by the painting of the interior in white, and the machine equipment is finished throughout in white enamel paint.

FIG. 3.—HEATING PLANT.

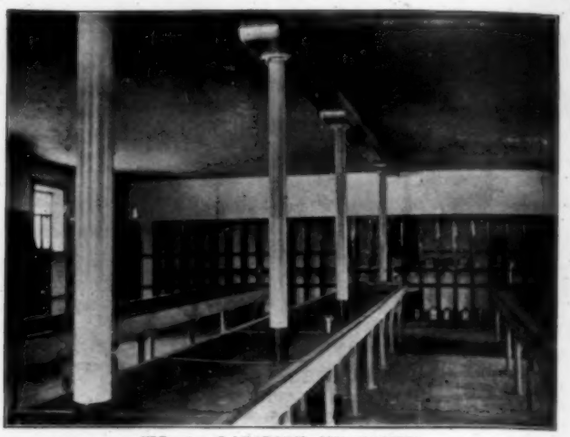


FIG. 4.—LAVATORY AND LOCKER.

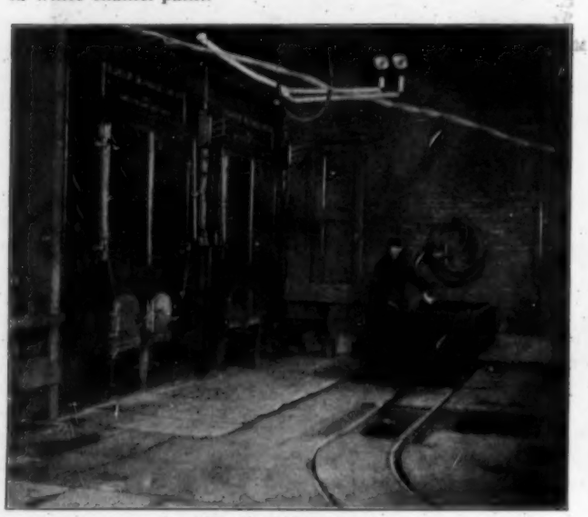


FIG. 5.—BOILER ROOM.

The shop is arranged with a two-story central part entirely free from obstruction and running the entire length of the building. This is about 60 feet in width and is to serve as the erecting and testing floor. The bays on either side are occupied by machines, tool room, heating and ventilating plant, etc. The erecting floor is served by a pneumatic traveling crane of sufficient capacity to handle the heaviest parts of the machinery manufactured. One of the engravings shows it in the act of conveying a compressor bed from one end of the shop to the other. Air is conveyed to the crane by a flexible hose suspended upon wires at the side of the craneways, and which festoons into loops or straightens out along its supporting wire according as the crane moves toward or from the fixed point from which air is supplied. The connection between the end of the crane and the traveling carriage is made in the same way.

A particularly interesting feature of this shop is the testing floor. On either side of a spur track, which enters the end of the building to a distance of about 65 feet, are set, upon solid foundations, pairs of 15-inch I-beams perfectly leveled and flush with the floor. These are permanent testing beds and permit the testing of 10 or more compressors at once. Space for the flywheel is provided in openings covered by removable iron plates beside each bed, which afford a level floor when the beds are not in use. From the testing beds the compressors may be loaded directly on cars for shipment.

The machines, many of which are of special pattern, are of the latest type of the machine maker's product, and were furnished by leading manufacturers. The building is thoroughly heated and ventilated by an equipment furnished by the Buffalo Forge Co., and partly shown in one of the engravings. The same illustration shows also the manner of supporting the shafting for such machines as are outside the bays, which shafting is driven from the main lines of shafting within the bays.

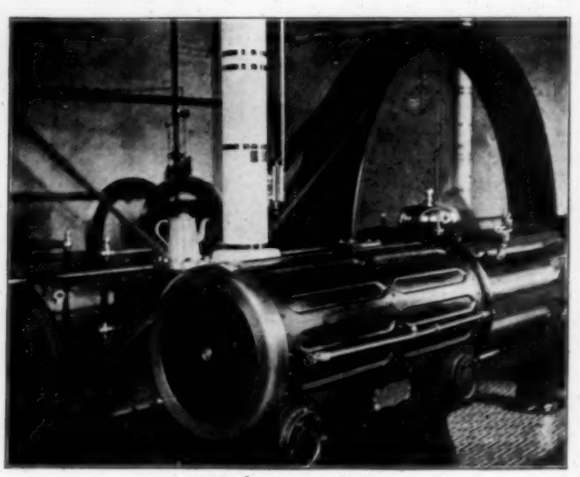


FIG. 6.—ROPE DRIVE.

Power is conveyed from the engine room by means of a rope drive. The drive passes through a tunnel between the engine room and the machine shop and also under the floor of the machine shop to the lines of shafting upon each side. The shafting is arranged with reference to groups of machines by means of clutches, so that a limited number of machines of the whole equipment may be in operation at once.

The pattern shop is a model in its way and is thoroughly equipped for the delicate work to be done there. The forge

shop is not an extensive part of the establishment, but its equipment of forges, Bradley hammers, etc., shows that it has received its proper proportion of attention.

The boiler room contains one feature which is attractive and does much to make this usually dingy and dirty apartment itself attractive. This is the arrangement for bringing coal to the furnaces from the supply outside. Coal is brought upon an elevated track and dumped into a space connected with the boiler room by the track shown in the engraving of the boiler room, on which runs the car also shown in that view. This car has sides perhaps 18 inches in height, the one in the side toward the furnaces being arranged to drop in a manner similar to the end board of a farm wagon. The coal is brought from the storage room to the furnaces in this car, and is thence shoveled directly into the firebox. The arrangement is not only easy for the fireman, but saves any trace of coal upon the floors.

The lavatory arrangements are unusually complete. A fairly complete understanding of them is given by an engraving herewith. Hot and cold water are supplied in several long basins in the room set apart for this purpose in the annex behind the superintendent's office, and the walls of the room are filled with lockers made entirely of expanded metal. The ease of cleaning by air or water with a hose is obvious. Ample closet facilities are also provided.

Above the superintendent's office is the draughting room, lighted upon three sides. The equipment of drawing board stands is interesting, the stands being made of piping. They are absolutely rigid as a support and capable of every necessary adjustment. They are also provided with bolts for permanent attachment to the floor. Convenient blue printing facilities and a well arranged and fitted up dark room for photographic work are included in the equipment of the room.

THE BRITISH IRON MARKET.

The iron and steel and allied trades have been dull again during the past week, and further reductions in prices are reported. In the pig iron market, as in other branches of the trades, business is very small, and there is a weak tone all round. Finished materials are no better off. Transactions are of a hand-to-mouth character, and prices have fallen away again in many districts. There is no change to report in the engineering trades, and the ship-building industry remains without much alteration. Our American correspondent cables that the Carnegie-Morgan deal has been put through, but that the effect upon the market is as yet uncertain. The Continental markets are still in a very unsatisfactory condition, trade being very quiet, and prices remaining down at a low level.

Pig Iron.—Business in pig iron is still confined with very narrow limits, the continued downward movement in prices being sufficient to convince buyers of the advisability of operating only for their immediate needs. The increase in business for spring delivery usually experienced at this season of the year is not yet in evidence, and accordingly the trade are again taking a somewhat despondent view of the present position and of future prospects. No doubt matters would speedily improve if prices could be steadied up a little; but while they are falling it is useless to expect buyers to enter into any extensive engagements. In the Cleveland district the market for hematite is weaker than that for ordinary iron, mixed numbers being reduced to 60s, while in Barrow the demand is equally poor. The following is a statement of the public stocks of pig iron in tons:

	Tons.	Changes during 1901. Increase Tons.	Decrease Tons.
Connal's at Glasgow	64,900	—	6,600
Connal's at Middlesborough	54,341	12,00	—
Railway Stores, Middlesborough	14 900		
Connal's at Middlesborough, hematite	405	—	150
Hematite, West Coast	28,491	5,891	—

Manufactured Iron and Steel.—There is no improvement in the finished branches of the trade. Business is still very dull, and a number of reductions in prices, some of them rather important, have taken place during the past week. In Middlesbrough bars have come down 5s. per ton, and common iron is now £6 15s., best at £7 5s., and best best at £7 15s. Plates, too, have been reduced 10s. per ton, making steel ship descriptions £6 5s., while iron and steel ship angles are down to the same figure. Iron sheets now stand at £8, and steel at £8 10s.; packing iron realizes £6 5s.; and galvanized corrugated sheets £11 for iron, and £11 10s. for steel. Other reductions are also reported from this district. Some of the North Staffordshire makers have sent out circulars bringing their list basis for bars down 10s., to £7; but the leading houses are still quoting £7 10s. In Lancashire, however, the official rate has been reduced to £7.

Engineering and Shipbuilding.—Throughout practically all branches of the engineering trade, apart from one or two special sections, there are reports of slackening activity, and an unsatisfactory outlook for the immediate future. Generally, however, there is a fair amount of work in hand, at any rate for the present, but this is running out without being replaced, and a not very distant period of slackness would seem to be in prospect. The labor returns of the trade unions also show a lessened demand for workmen, the leading societies having to report a gradually increasing number of out of work members on their books. There is little fresh to report in the shipbuilding industry.

Foreign.—On the Continent trade is very quiet. The amount of rolled iron going into consumption in France is of such small extent that mill and forge owners have been obliged to discharge a large number of hands, and in all the districts production is being restricted in every possible way. The situation of the finished iron trade in Belgium is very unsatisfactory, as not only are makers competing very keenly for the few orders being given out, but they find the ground cut from under thier feet by German firms. Trade in Germany continues dull.

Comparison of Prices.—The annexed table shows the current prices compared with those of last week, and of the corresponding period last year:

	Mar. 1, 1901.	Feb. 21, 1901.	Mar. 2, 1900.
IRON ORE—	s. d.	s. d.	s. d.
Rubio, Middlesbrough	15 6	15 6	21 6
" Cardiff	15 6	15 3	20 0
Pottery Mine, North Staffordshire	20 6	20 6	17 6
Hematite, West Coast (at mines)	18 0	18 0	17 6
PIG-IRON—			
No. 3 foundry, Middlesbrough	46 0	46 6	69 9
Warrants	45 4	46 4	68 9
Scotch warrants, Glasgow	52 7	54 6	68 1
Hematite warrants, West Coast	59 3	59 6	77 2
Cold blast (foundry), South Staffs	120 0	120 0	130 0
Welsh hematite, Cardiff	60 0	65 0	85 0
MANUFACTURED IRON & STEEL—	£ s. d.	£ s. d.	£ s. d.
Marked bars, South Staffordshire	9 10 0	9 10 0	11 10 0
Common bars "	7 15 0	7 15 0	10 10 0
Steel rails, Middlesbrough	5 12 6	5 18 6	7 7 6
" West Coast	5 17 6	6 0 0	7 0 0
" Cardiff	5 17 6	5 17 6	7 5 0
Steel angles (eng.), Middlesbrough	6 12 6	6 17 6	8 10 0
" " Glasgow	6 15 0	6 13 0	8 5 0
Steel plates (ship), Middlesbrough	6 5 0	6 15 0	8 5 0
" " Glasgow	6 15 0	6 15 0	8 10 0
Tinplates, Bessemer I. C. cokes, South Wales	s. d. 12 9	s. d. 13 0	s. d. 16 0

—[Iron and Coal Trades Review, London, March 1.]

The W. B. Pollock Co., Youngstown, O., has closed the deal for the Himrod furnace property. Work on the new plant will commence shortly. It will consist of four principal buildings and several smaller ones. The main building will be the erecting and machine tool department, and will be of steel frame construction, 120 x 300 ft. The Morgan Engineering Co., Alliance, O., will furnish two 20-ton, one 10-ton, and two 5-ton electric traveling cranes for this building. The forge building will be of steel, 60 x 175 ft., the cranes for which will be supplied by the Whitney Fdy. Supply Co., Chicago. The warehouse will be of steel, 60 x 140 ft., and the engine and power house of brick, 50 x 100 ft. The new plant will about double the capacity of the present plant. The company will supply its own power, heat and light by an electric plant. Most of the contracts for machinery and equipment have been let. The property vacated by the Pollock company passes into the possession of the Wm. Tod Co.

The new wage agreement of the International Association of Machinists, to be presented to machine shop proprietors about April 1, and to go into effect May 20, provides for a 9-hour work day, with 10 hours' pay, time and a half for overtime until midnight, and double time after midnight, and on holidays and Sundays.

HIGH-SPEED TOOTHED GEARING.*

BY JAMES CHRISTIE.

For the transmission of power it frequently becomes necessary to use toothed gearing, subjected to high peripheral speed conjointly with high pressure per unit of tooth contact, and the object of these remarks is to record what has been successfully done in recent years, as much higher speeds are now successfully attained than formerly. Considered in a static sense, the gear tooth satisfies the condition of stress if it is proportioned to endure forces acting traverely on it, and the pressure per unit of contact is not such intensity as permanently to deform the curved bearing surface of the teeth. When in motion, the curved surfaces slide upon each other as they enter and leave contact, and when this sliding action is accompanied with high pressure, the limit of endurance is soon reached, and in the case of the inferior materials this occurs at comparatively low speeds and pressures. In addition to this, more or less impact usually occurs, especially when the resistance is of a fluctuating character or the loads are suddenly applied. The effects of this hammering action are discernible by a flattening of the curved faces of the teeth, after which the proper engagement of the teeth ceases and the gear is speedily destroyed.

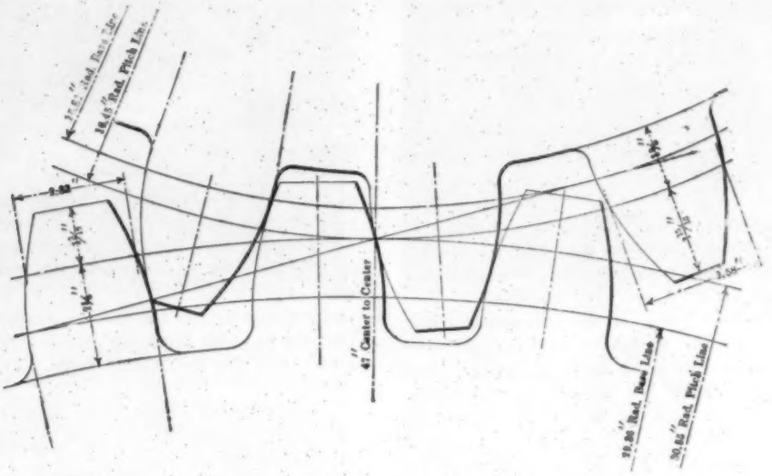


FIG. 1.

To prevent this, it is desirable to cut the teeth so accurately that no side clearance or "back lash" exists, and this is now usually done on first-class gearing of even the largest dimensions. Owing to the low elastic limit of cast iron and the bronzes we cannot expect these metals to endure so high a pressure as steel, and steel appears to be the most trustworthy material to endure the highest pressures and speeds. This assertion, however, does not apply to all grades of steel. Soft steel surfaces abrade or cut very readily despite all methods of lubrication, and surfaces of this material should never be allowed to engage in sliding contact. Gearing of soft steel is usually destroyed by abrasion at quite moderate speeds. Rolling-imll pinions of steel, containing 0.3 per cent carbon, have been destroyed in a few months, whereas the same pattern in steel of 0.6 per cent carbon has done similar work for several years without distress. Of course, it is necessary to shape the teeth to a proper curve to insure proper engagement and uniform angular velocity.

Some years ago there was required suitable gearing to connect the engines to a rolling mill in this vicinity. The diameters of the wheels were 37.6 and 56.4 inches respectively. They were intended to revolve at speeds of 150 to 100 revolutions per minute and expected to transmit about 2,500 horse power. The character of the service was such that renewal was a serious matter and long endurance very desirable. A high grade of steel was selected, especially in the pinion, in which the greatest wear would occur, and which, owing to the location, was the most difficult to replace. The pinion was forged from fluid compressed steel of the following composition:

	Per cent.
Carbon	0.86
Manganese	0.51
Silicon	0.27
Phosphorus and sulphur, both below	0.03

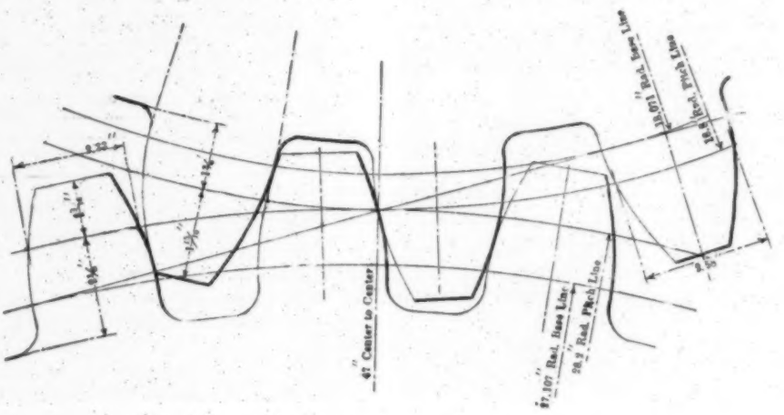


FIG. 2.

The spur wheel was an annealed steel casting:

	Per cent
Carbon	0.47
Manganese	0.66
Phosphorus and sulphur, both	0.05

The tooth dimensions were: Pitch, 4.92 inches; face, 24 inches. (See Fig. 1.)

These were accurately cut with involute curves generated by a rolling tangent of 16 degrees obliquity. No side clearance was allowed. After starting the mill, it was found that a higher speed was practicable than was originally contemplted. Higher pressure on the teeth were also applied, so

* Read before the Philadelphia Society of Engineers.

that ultimately about 3,300 horse power was transmitted through the gearing, corresponding to a pressure of nearly 2,100 pounds per inch of face. The speed was variable, but occasionally attained a velocity of 260 revolutions per minute for the pinion, corresponding to a peripheral velocity of 2,500 feet per minute. This gearing has been in constant operation for several years and behaves satisfactorily.

The highest recorded speed for gearing that I can recall is that described by Mr. Geyelin in the Club "Proceedings" of June, 1894. The mortise bevels had a peripheral velocity of 3,900 feet per minute, but the pressure per inch of face was only about 680 pounds, the diameter and speed being made high to reduce the pressure on the teeth. I understand that the lifetime of these bevels is not long. If made of a grade of steel, as previously described, their diameter and speed could be considerably reduced, and prolonged endurance tion was made to another mill, the gear having a different would be realized.

About the same time No. 1 was installed a similar applica- speed ratio, and the angular velocity being lower (see Fig. 2):

	Pinion Per cent	Wheel Per cent
Carbon	0.90	0.60
Manganese	0.64	0.64

A much larger set had been previously employed, transmitting about 2,400 horse power at 750 feet per minute peripheral speed, involving a pressure per inch of face of 3,500 pounds. This latter pair were 4 feet and 8 feet respectively, 7½-inch pitch, 30-inch face, cut with involute teeth of 14 degrees obliquity. (See Fig. 3.)

	Pinion	Wheel
Carbon	0.52	0.42
Manganese	0.55	0.73
Silicon	0.107	0.279
Phosphorus	0.022	0.078
Sulphur	0.02	0.05

These gears have all rendered excellent service, and today are apparently as good as at the beginning.

As considerable expense is involved in cutting large gears of hard steel, it is sometimes practicable to rough-cut the gear after it is made as soft as possible by slow cooling, a higher degree of hardening being imparted before final finishing by air hardening or rapid cooling from the refining heat. This is not infrequently done in the case of screws and gears of moderate dimensions. In this event it is desirable to have the ratio of manganese low, say, not over 0.5 or 0.6 per cent—as a high manganese content seems to impart a permanent hardness that is not readily reduced by slow cooling.

It appears to be practicable to maintain sliding surfaces of steel if one of the surfaces is hard, even if the other is comparatively soft; but for steel gearing for ordinary purposes, I would suggest the use of steel not less than 0.4 carbon. If the speeds and pressures are unusually high, a much harder grade of steel becomes necessary. When a small pinion engages with a large wheel, the former alone can be made of high-grade steel approaching to a carbon content of 1 per cent. When extreme speeds and pressures become necessary, the best results will be found by using in both wheels steel having a carbon content approaching 1 per cent, or an equal hardness, obtained by lower carbon and high manganese or other desirable hardening addition. With gearing accurately cut from steel of this character and securely mounted, it is believed that reasonable endurance will be obtained when the product of speed and pressure, divided by pitch, each within certain limits, does not exceed 1,000,000; for example, a speed of 3,000 feet per minute and 1,600 pounds per inch of face, or *vice versa*; for gear of 5-inch pitch, assuming, so far as we know, a maximum speed of 5,000 feet per minute for gear of any pitch, and permissable pressure to be proportional to the pitch.

This statement that speeds and pressures are reciprocal, or as one is increased the other must be reduced, in a fixed ratio, may not strictly be a rational one, but in a broad and general sense it is correct within the usual limits of practice.

It will be understood that such a generalization as herein stated would apply to pinions having a liberal and not the minimum number of teeth.

Discussion.

Mr. E. Graves gave particulars of three duplicate sets of cast-steel bevel wheels. The pinions are the drivers and are 57.39-inch pitch diameter and have 36 teeth, 5-inch pitch, 20-inch face. The wheels are 74.8 inches diameter and have 47 teeth. The teeth are carefully cut to involute lay-out and are 3.43 inches high. The normal speed of the pinion is 360 revolutions per minute, giving 200 revolutions per minute to the wheel and nearly 4,000 feet circumferential speed on the pitch line. The horse-power transmitted is 1,300. Assuming the entire load to be distributed along the outer end of one tooth, the fiber strain would be 2,100 pounds per square inch at the root of the tooth.

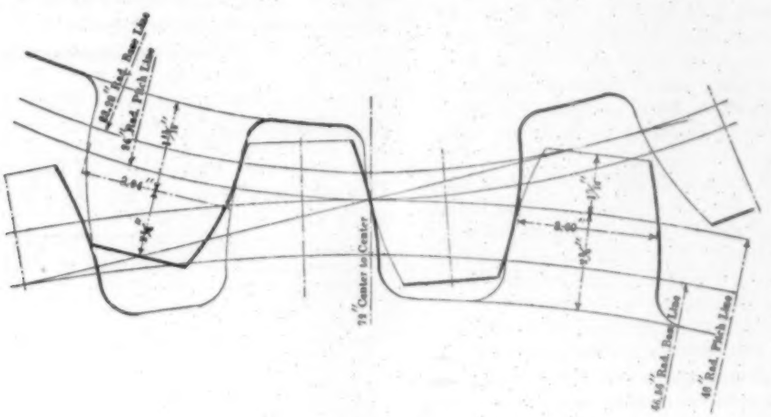


FIG. 3.

The pinion is mounted on the upper end of a 10-inch shaft, 148 feet long, with a turbine wheel at the lower end. Both shafts extend through the gears and are reported in a massive bridge casting with adjustable bearings. The gears are enclosed in a casing and are lubricated with oil fed under pressure through several jets applied just in front of the teeth as they mesh together.

The gears have been in service for five years, but have not been entirely satisfactory. Their wearing power in the sense of resisting abrasion is satisfactory, but the teeth break. This breakage is confined to the pinion, the nature of the break being the same in all cases, beginning at the large end, cracking around the root and following along the tooth. The quality of the steel in castings is the ordinary commercial article. The widest variation in analysis observed is, in one instance:

Silicon	0.25
Sulphur	0.036
Phosphorus	0.071
Manganese	0.74
Carbon	0.31

Another:

Silicon	0.27
Sulphur	0.03
Phosphorus	0.032
Manganese	0.80
Carbon	0.23

As is to be expected, the softer metal has resisted breaking the longer. In two sets of these gears the resisting work is of a varying nature with sudden and wide fluctuations; in the third instance the working is more constant. This variation of conditions does not seem to have influenced failure, as the teeth have broken in all the sets.

One of the practical difficulties in operating bevel gears of the nature described is the difficulty of holding them so that they will be in proper contact; longitudinal motion in either shaft throws them out of pitch. The most serious problem, however, is in securing and maintaining shafts so that the extended axis-lines of same pass through a common point. The effect of power transmission from pinion to gear is to put these axis-lines out of position, moving them in opposite directions and resulting in end contact of teeth and concentrated load instead of evenly distributing the load along the whole length of tooth. In this particular the question of maintaining bevel gears is decidedly more of a problem than that of spur gears. In this latter case small end motions of carrying shafts produce no effect, while the wearing of bearings is only the shifting of pitch-line, and, as it occurs slowly, it will, within reasonable limits, adjust itself.

As a matter of further interest, I will mention that in this same room with these gears are three other sets of bevel gear having cut-steel pinions and mortise wheel with cast-iron rims. The diameters and ratios of these—speeds, mountings and service—are practically the same as those described, but the transmission of power is 1,100 instead of 1,300 horse-power. The pinions have 33 teeth, 5½-inch pitch, with 20-inch face, the teeth being planed down to 2½-inch thickness on pitch-line. The wheels have 43 teeth. These gears have been in service some seven years. None of the pinions has even given way; the wooden teeth in the wheels, however, last only from six weeks to two months, an extra rim being kept on hand for refilling and replacing.

Mr. Lewis in further discussion of the paper said in substance: In regard to the pressures carried by gear teeth, Mr. Christie seems to lay down a rule making the product of speed and pressure constant. This would reduce the load in proportion to the speed, and it seems to me an open question whether that should be adhered to or not. I do not think it has been demonstrated how the pressure of the teeth should vary with the speed. Some experiments, I think, should be made which would indicate that more clearly than has heretofore been done. It is interesting to note his remarks regarding the influence of the hardness of the metal upon the pressures carried, and instead of reckoning the pressure by the inch as so much per inch of face, it seems to me the pitch should also be included, because the face of a gear tooth is very much like a roller, and the pressure carried by a roller varies with its diameter as well as with the face. Some authorities seem to think that it should vary with the square root of the diameter; others directly with the diameter, and I am inclined to the latter opinion. If gear teeth are proportioned for strength, they are also proportioned for wearing pressure and surface to carry the load.

Mr. W. Trinks: I wish to call attention to an article on high speed gearing in the November and December numbers of the "Zeitschrift des Vereins deutscher Ingenieure," 1899, by the chief engineer of the General Electric Company, at Berlin, Germany. The experiments show that there is no rule for the relation between pressure and speed; it depends upon accuracy; the load on the teeth may be the higher the more accurately the gears are made. A remarkable method of manufacturing gears was the outcome of the experiment. The curves are laid out on paper three or four times the size of the real tooth, reduced to proper size by photography, transferred on sheet steel, and etched in. Thus the highest degree of accuracy is obtained.

It was found that neither cycloidal nor involute curves gave the best results. Another curve was developed with a view to reducing the sliding motion between the teeth. The article contains very interesting diagrams on this point. By dividing the length of two working teeth into an equal number of parts, the amount of sliding action can be determined and the fact shown that it is reduced to a minimum by these methods.

Another thing shown by the paper is never to place a flywheel close to a gear. If possible, have a good length of shaft between. Slight inaccuracies in the pitch of the wheel require acceleration or retardation of the mass, and in order to do this force is needed. This force causes a hammering on the teeth which may break them; in other words, plenty of elastic material should be between the inertia masses and the gears. I feel pretty sure that all engineers will be much interested in the article; it is a valauble treatise on high-speed gearing.

Mr. Christie: The bevel gears described by Mr. Graves are very interesting and useful as a record. It is much more difficult to obtain satisfactory results with bevels than with plain spurs, as any deviation from correct alinement is fatal to correct tooth action in the former. In this instance, while speed is very high, the pressure on the teeth is comparatively low—about 750 pounds mean pressure per inch of face. Thus the products of speed and pressure in relation to the pitch are considerably below the quantity assumed as a safe maximum. Regarding the quality of the material, the manganese is too high. While steel of this composition would be moderately hard and wear fairly well, it would be somewhat brittle. It is not surprising to learn that some teeth gave way by fracture. If the relative proportions of carbon and manganese in the steel were reversed, it would be a much better material for the purpose.

OUTPUT OF BLAST FURNACES OF UNITED STATES.*

March 1, 1901.

Location of Furnaces.	Coke and Anthracite.					Charcoal.				
	Total No. of Stacks.	In Blast.		Out of Blast.		Total No. of Stacks.	In Blast.		Out of Blast.	
		Number.	Weekly capacity.	Number.	Weekly capacity.		Number.	Weekly capacity.	Number.	Weekly capacity.
New York	14	3	4371	11	7757	2	2	237	0	0
New Jersey	8	3	2145	5	2695	.....	.....	.....	.....	.....
Spiegel	3	3	589	0	0	.....	.....	.....	.....	.....
Pennsylvania:						13	2	95	11	500
Lehigh Valley	29	18	10692	11	4387	.....	.....	.....	.....	.....
Spiegel	1	1	129	0	0	.....	.....	.....	.....	.....
Schuylkill Valley	13	8	6847	5	3197	.....	.....	.....	.....	.....
Upper Susqu. Val	4	3	3356	1	336	.....	.....	.....	.....	.....
Lower Susqu. Val	9	4	4704	5	1996	.....	.....	.....	.....	.....
Spiegel	1	1	512	0	0	.....	.....	.....	.....	.....
Lebanon Valley	13	11	9706	2	1450	.....	.....	.....	.....	.....
Pittsburgh Dis't	32	27	62013	5	8975	.....	.....	.....	.....	.....
Spiegel	1	1	1986	0	0	.....	.....	.....	.....	.....
Shenango Valley	15	10	14399	5	5103	.....	.....	.....	.....	.....
West'n Pennsylvania	23	13	18200	10	5811	.....	...	.....	...	.....
Spiegel	1	1	850	0	0	.....	.....	.....	.....	.....
Maryland	5	4	6390	1	1200	4	0	0	4	443
Wheeling District	8	7	10671	1	1470	.....	.....	.....	.....	.....
Ohio:						.....	.....	.....	.....	.....
Mahoning Valley	13	12	24500	1	1617	6	1	72	5	344
Central & Northern	14	12	23860	2	2082	.....	.....	.....	.....	.....
Hocking Valley	2	2	800	0	0	.....	.....	.....	.....	.....
Hanging Rock	14	9	4629	5	1462	.....	.....	.....	.....	.....
Illinois	16	14	28102	2	3120	.....	.....	.....	.....	.....
Spiegel	1	1	860	0	0	.....	.....	.....	.....	.....
Minnesota	1	0	0	1	763	.....	.....	.....	.....	.....
Wisconsin	5	3	2971	2	1854	.....	.....	.....	.....	.....
Missouri	1	0	0	1	570	.....	.....	.....	.....	.....
Colorado	2	1	1550	1	1550	.....	.....	.....	.....	.....
Virginia	20	15	9997	5	2586	3	0	0	3	192
Kentucky	5	3	969	2	1370	3	0	0	3	200
Alabama	38	26	23859	12	7234	4	3	984	1	325
Mich., Mo. and Wis.	.....	.....	.....	.....	.....	13	10	4775	3	1225
Tennessee	12	6	5168	6	3747	6	3	1136	3	400
Georgia	1	0	0	1	450	4	1	369	3	549
North Carolina	2	0	0	2	437	.....	.....	.....	.....	.....
New England	.....	.....	.....	.....	.....	7	3	280	4	360
Texas	.....	.....	.....	.....	.....	4	1	126	3	775
Utah	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oregon	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	327	222	284825	105	73139	69	26	8074	43	5310

SUMMARY.

Fuel.	In Blast. Number.			In Blast. Weekly Capacity.			Out of Blast. Number.		Out of Blast. Weekly Capacity.	
		Month Previous.	Year Previous.		Month Previous.	Year Previous.		Month Previous.		Month Previous.
Charcoal	26	31	29	8,074	8,335	7,047	43	38	5,310	4,960
Coke and Anthracite	222	210	264	284,825	269,923	285,596	105	112	73,139	77,597
Total	248	241	293	292,899	278,258	292,643	148	150	78,449	82,551

*Condensed from the *Iron Age*. The decrease of unsold stocks, so far as these are reported, (none of the stocks of the steel companies being included) was from 556,764 tons Feb. 1 to 535,443 tons March 1, or about 21,000 tons.

HISTORY OF THE 4-INCH STEEL BILLET.

We have from Wm. Garrett, of the Garrett-Cromwell Engineering Co., Cleveland, the following copy of an article he prepared recently for publication in one of the iron and steel trade journals of London, with a view to showing the disadvantage under which British steel manufacturers labor in refusing to adopt the 4-inch billet of American practice:

To the Editor:

In the year 1876, the Cleveland Rolling Mill Co.'s plant, of Cleveland, O., was well in advance of the steel works of that time, having a Bessemer steel plant, rail mill, merchant bar mills, a wire mill, ranking second in production in the country, and two wire rod mills, which were the equal in output of any in the country, each mill making from 18 to 20 tons in 24 hours. The size of the billet used for making wire rods (the standard rod at that time being No. 4) was from 1⅛ inch to 2 inches square. These were cut into lengths of about 35 to 40 lbs. in weight. To get this billet the ingot (which was about 9 inches square at the large end and from 850 to 900 lbs. in weight) was heated and afterwards hammered to a 5-inch square bloom. At this stage it was cut into pieces of about 150 lbs. each. These were taken and re-heated, and then rolled on an ordinary 18-inch three-high mill into 1⅛ inch billets, or in some cases into flat bars, 1⅜ inch x ⅞ inch, these being afterwards cut into lengths weighing from 35 to 40 lbs., as mentioned above.

At the plant of the Cambria Iron Co., Johnstown, Pa., and also at that of the Troy Steel Co., Troy, N. Y., it was at that time the custom to take a 12 inch or 14 inch ingot, bloom it down to 7 inches square and cut it into lengths of about 600 lbs. in weight. These were re-heated and rolled into 1⅛ inch square billets at one heat, after which they were cut into the lengths required. At that time this was considered a remarkable feat—the rolling of a 7-inch square bloom of 600 lbs. in weight into a 1⅛ inch square at one heat. The system was so profitable and practical that it became the popular and almost universal method of making billets for wire rod purposes, and from that period to 1882 this was the recognized practice. In all that time, both in the United States and abroad, nothing had been done to improve the practice in the manufacture of a billet for wire rod purposes. In the meantime, owing to the adaptability of Bessemer steel for the manufacture of good wire, the wire business had increased to an enormous extent, so much so that in the year 1879 over 170,000 tons of wire rods were imported by the United States from Germany, not to speak of what we made ourselves, and the many thousands of tons made in Great Britain and on the Continent for other purposes. All of this tonnage was made from a 1⅛ inch to 2 inch billet, produced in the manner described above. In fact, so fixed had the idea become that this was the logical and the best size of billet for making wire rods that in the year 1862 the Washburn & Moen Mfg. Co., of Worcester, Mass., had just finished remodeling all of its wire rod mills at a great expense so as to adapt them to the heating and rolling of a small long billet with the least possible labor.

Advent of the Four-Inch Billet.

In the year 1880, the Cleveland Rolling Mill Co. took a bold step with a view to reducing the cost of making wire rods from the ingot. Being aware that the heating and rolling of a 7-inch rolled bloom, or a small billet rolled from a hammered 5-inch bloom, cost between $5.50 and $6 per ton, they began to devise some means whereby an ingot could be rolled into wire rods without this extra re-heating and rolling. After due reflection they decided to adopt an ingot of a certain size and roll it into a small bloom that it would be practicable to heat and roll into wire rods at the one heat. The size of the ingot decided upon at that time was 14 inches square and of about 3,400 lbs. in weight, and the billet to be rolled direct at one heat into wire rods was 4 inches square. In order to demonstrate this — at that time a theory — they had to erect a 2-high reversing blooming mill, and a rod mill adapted for rolling a 4-inch billet in wire rods at one heat. These changes cost them a large amount of money — not less than $375,000. It is needless to point out the suspense and anxiety of the leaders in this project during construction, which covered a period of two years. However, the results were most remarkable, not only ultimately but immediately, as in addition to reducing the cost of rolling the bloom into a billet suitable to be rolled into wire rods, the method also reduced the cost of rolling the wire rod from the billet. For instance:

Cost of rolling a 7-inch or 5-inch bloom to a 1⅛-inch or 1½-inch, including fuel for steam and heating, loss in crop ends, and total labor	$6.00	
Total rolling labor alone paid at that time for rolling a 1⅛-inch square into No. 4 rods	5.10	$11.10
Total rolling labor for converting 4-inch billet into No. 4 rods		4.00
Difference in favor of 4-inch billet		$ 7.10

In addition to the above, while in November, 1882, the average tonnage per 24 hours, on the old style mills using 1⅛-inch billets, was 36 tons, on the new mill in the same month (the third month from starting it) the average was over 72 tons per 24 hours.

Creating a New Steel Product.

This move on the part of the Cleveland Rolling Mill Co. revolutionized the art of wire rod rolling, and also created a new article of commerce, i. e., a 4-inch Bessemer steel billet. The leading spirit of this movement, and the one who furnished the capital required to achieve the above results, was the late Henry Chisholm, then president of the above company. The result was far reaching. The Washburn & Moen Mfg. Co. changed all their rod mills so as to take a 4-inch billet; the owners of all small guide mills changed and strengthened their mills so as to take a 4-inch billet. In many cases guide mills 9-inch diameter were adapted to use that size of billet. Efforts were made to use a 4-inch billet when rolling ½-inch rounds or ⅞-inch x 3-16-inch flats on a 9-inch train, and to spread same to 7-inch wide flats and all sizes under in width, as an irregular billet either costs a little more or cannot always be made as readily as a 4-inch billet. Billets of this size became as staple as a barrel of flour, and money was loaned on them more readily than on pig iron. All blooming mills built in this country since that time are adapted to make a 4-inch billet, and the largest tonnage of that size of billet rolled direct on one set of rolls, starting with an 18x20-inch ingot weighing about 6,000 lbs., is 1,267 gross tons per double turn—this by the Lorain Steel Co. of Lorain, O. It is safe to assert that over 3,500,000 tons of 4-inch billets were made in 1899.

Foreign Markets Refuse the Four-Inch Billet.

In spite of all the advantages shown above, of using a 4-inch billet in place of one 2 inches or smaller, it has been almost impossible to sell that size of billet abroad. Although the above results, made public through the press and other sources, became widely known, the British steel manufacturer was compelled to furnish small billets to the wire rod and small merchant steel makers; and in order to secure trade with Great Britain the American manufacturer had to devise some means of making small billets 1½ inches square, etc., or under 4 inches square. Notable among the changes that were made to bring this about was the locating of a continuous train near the blooming mill. On this continuous mill the entire billet is rolled into 1½ or 2 inches square in one piece, without re-heating, the finished bar being cut into 30-ft. lengths, etc., as it emerges from the last pass. The continuous billet mill with flying shear attachment is one of the finest rolling mill devices we have for this purpose, enabling a 2-inch billet to be sold for $1 per ton above the selling price of a 4-inch billet on the open market.

However, are the small users of billets, such as for wire rod purposes, entirely to blame for this? Did the steel manufacturers of Great Britain use the same efforts as the American manufacturer to give their customers the fullest benefit to be derived from a wise expenditure of capital? I question this very much, judging from the fact that no concession has been made in favor of a 4-inch billet, and from the limited efforts made by British steel manufacturers during the past 25 years to cheapen the cost of steel in the shape of billets. Therefore, if their customers can buy cheaper steel billets abroad than at home, it is only a matter of legitimate business.

Practice in Germany.

But how about our German friends? During the period 1876-1882 they were using small billets for making wire rods,

etc. Did they stick to the traditional small billet of their grandfathers' time and import small billets from the United States? Not at all. In spite of a protective tariff against foreign material, they went to work and even outstripped the American manufacturers, insomuch that they use a 5-inch, 6-inch and 7 inch bloom, and in some cases small ingots of that size, and roll them into No. 6 wire rods at the one heat, first rolling the bloom down to about 1½-inch square and cutting it at that point into two or three other parts, and then rolling these one after the other into finished rods. The writer was an eye witness to this practice, and it sent him home to the United States a wiser man.

In Germany recently, a large wire manufacturer allied himself with a steel manufacturer, and the first thing they did was, not to put in expensive and costly additions to make a small billet, but to go to work and put in the very best rod mill that money could buy, suitable to take a 5-inch bloom, and adopted all the latest American devices in connection with it.

Today Great Britain is flooded with American and German steel products, while she sighs at the departure of her glory and supremacy, blaming the lack of raw material, lack of protection, and the independence of her workmen, for these conditions. There is some truth in all this, yet the fact remains, judging from the above, that she has not done all she can to help herself, and "Heaven only helps those who try to help themselves."

Bearing of Birmingham and Sydney Plants on the Question.

Within the last two years two events have transpired that should interest at least those in Great Britain who require basic open-hearth steel in the shape of ingots, blooms, or billets. Almost at the extreme south of North America, and within a reasonable distance of the seaboard, there has been organized and put in operation a large open-hearth steel plant, of about 1,000 tons daily capacity—to produce steel in the shape of blooms and billets down to 4 inches square. I refer to the Tennessee Coal, Iron & Railroad Co.'s plant at Birmingham, Ala. It is maintained that the cheapest pig iron in the world can be made in that district, and one of the main objects in erecting that plant was to supply Great Britain with material in the shape of 4-inch billets. Last year one of the agents of this company was over in Great Britain, looking up the trade with a view of securing large orders for that size, or billets they could manufacture cheapest. I have been informed that the results were very discouraging, as nobody wanted to buy 4-inch billets, but must have a small billet to suit their present rod and merchant mills, many of which were designed and erected a generation ago. The cry was for small billets or none.

There is also a large open-hearth steel plant under construction at Sydney, N. S. The people building this plant have their own coal and ore mines, and are putting in by-product ovens for the purpose of making their own coke. They are about 1,000 miles nearer the British seaports than is New York. They also have their agents abroad trying to get a market for 4-inch billets, but in spite of these advantages, the British manufacturer will have nothing but a small billet. What matters it if the American Steel & Wire Co. make the cheapest salable wire in the world, or Germany undersells British manufacturers in all steel products, German manufacturers having changed from their grandfathers' method of making wire rods and merchant steel bars. It appears the British buyers are like Ephraim, joined to their idols, and will have nothing but the small billet.

Changes In Practice Needed.

It must not be understood that the substitution of a 4-inch for a 2-inch billet will alone cure all the evils that the British steel makers are heir to at the present time. Not at all. They must remodel and improve their present finishing mills and heating furnaces, so as to take the 4-inch billets, heat and roll it in the most economical way into finished bars.

To give your readers an idea of what can be done on a first-class wire rod mill, starting with a 4-inch billet, I cite the output of a wire rod mill located at Joliet, Ill, (a part of the Illinois Steel Co.) made in December, 1900:

In 48 single turns 9,643 gross tons of No. 5 rods, or an average of 201 tons. The best single turn during this month was 245 gross tons No. 5 rods.

Coming to merchant steel bar practice on a modern mill, we have the mill at Mingo Junction, O., which has produced over 8,000 tons of finished bars in a single month, and over 320 tons in a double turn, rolling sizes ranging from 1½-inch round and square to ½-inch round and square including bars for rivets and bolts; flats 2½ inches wide to 1 inch wide, starting with a 4-inch billet.

We have mills in this country, erected at considerable expense, especially designed to reduce all labor around the heating furnace and rolls, and on which they begin with a 1½ inch to 3-inch billet, charging these billets in 30-ft. lengths. The mechanism for charging and drawing this billet ready to enter the rolls makes the operation almost mechanical. But when all is done one hard fact remains and cannot be rubbed out, and that is, that a 2-inch billet in open market—in spite of all the expensive improvements to cheapen it—costs $1 per ton above the 4-inch billet and $1 per ton covers a multitude of labor. The above is from an American standpoint, but British steel manufacturers have not these improved rolling mills, nor the heating furnaces referred to, but the old small finishing mills designed by their grandfathers.

Records of British and American Mills.

In the year 1889, while in a works in Great Britain, the writer saw them roll by hand a ¾-inch round bar, starting with a 3-inch billet, in about 16-ft. lengths, producing 8 to 10 tons a single turn. In the same year, in the United States, he saw them roll ¾-inch rounds by guide, in lengths over 250 ft. and producing over 10 tons per hour, or over 100 tons in a single turn.

In order to show the cheap production on American rod and merchant mills I will only refer to the figures given in the *Iron Age*, *The Iron Trade Review*, and *American Manufacturer* during the keen competitive period of 1895 to 1897. You will find that when Bessemer pig was selling at $9 per ton and 4-inch billets at $14 per ton, wire rods were selling at $19.50—or a difference of $5 per ton between pig iron and 4-inch billets, and $5.50 between 4-inch billets and rods. Bar steel has been sold at 90c per 100 lbs. or £4, 3s, 4d per gross ton. Thousands of tons of steel strips for making small tubes or pipe have been shipped to the vicinity of Glasgow at a price that netted the Pittsburg manufacturers at their works, £5 per gross ton; and to disprove the assertion that the American steel manufacturer sold his steel abroad cheaper than he did at home I will state that many thousands of tons of steel strips were sold in this country in 1896 for 85c per 100 lbs. or about £4 per gross ton, and the material was made from 4-inch billets, or slabs made in one heat from the ingot.

It is easier to handle 4-inch billets and ships them for export trade, as they can be piled like brick in the hold of a vessel, whereas small billets in long lengths are not so convenient to load and unload in transferring from docks to works. A short 4-inch billet can also be more conveniently handled and it has been proved beyond a doubt that in order to get a large output a 4-inch billet is much more suitable, for two or more heating furnaces can be placed to feed one finishing mill, whereas in the case of a long 30-ft. billet only one furnace can be used, which is placed close up against the first set of rolls of the continuous train, and the billet is in the heating furnace and continuous train at the same time. It has been proved beyond a doubt that a 4-inch billet can be heated with, if anything, less coal per ton of finished bars than when heating 2-inch billets.

Yet in spite of all these striking advantages the British manufacturers prefer to stick to small billets, preferably 2 inches cross section; and to crown all, the 2-inch billet in the open market is selling at $1 or 4s 2d per ton above the 4-inch billets, and the output is 125 tons per turn on the improved American mill against, say, 25 tons per turn on the old style British mills, and the cost between billets and finished bars nearly one-half less than the British cost.

Is not this burning the candle at both ends? And how long will the candle last under these conditions?

WM. GARRETT.

It is probable that the business of J. C. McNeil Boiler Co., at Akron, O., will be reorganized. A good showing has been made under the receivership, and some of the leading business men of Akron are desirous of putting the firm on a solid financial basis.

Timely Topics of the Shop.

Natural and Restricted Foundry Outputs.

Two cases of "before and after taking" were noticed recently in an Ohio foundry. One was the molding of a fan wheel with a rim and propeller-like blades. Formerly it took two men a day and a half to prepare one mold and then some one else had to do the pouring. Recently the two men have been able to mold and pour this particular piece all in one day. No change has taken place in the equipment of the shop meanwhile. This would seem to indicate a more healthy condition of affairs and a more hearty spirit of co-operation of the men with their employers. Such a condition means good wages to the men and a good profit to the firm. Arbitrarily limiting the output as some labor organizations and shop committees have tried to do works no good to either party concerned.

The other case is that of a piece of which 50 or 60 are wanted daily. Before, two molders, receiving the regulation wage, would each put up from 25 to 30 per day. They could have done 35 if they had tried. After, by use of a molding machine of prominent make, a laborer of good intelligence, paid less than $2 is making 55 or 60. The opposition to the introduction of improved machinery is opposition to progress, and is the rock on which more than one mistaken effort to unite workingmen has gone to pieces. J. P. M.

Up-to-Date Lathe Pans.

The question of providing pans underneath machine tools and especially lathes to catch oil and chips is bound to come up in a shop sooner or later; and this question finally resolves itself into one of dollars and cents. The point is, whether it is better to let the chips fall on the floor, to litter up and cause all the sweeping possible, or to catch them clean, and at the same time keep the floor cleaner. With screw machines and lathes, with the bed in a pan on legs, this question does not come up. It applies to the ordinary type of bed whose legs rest on the floor and through whose bed the chips and oil fall on the floor.

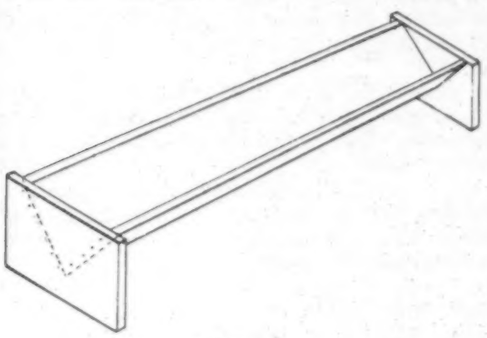


FIG. 1.

In the first place these chips are worth something, and the cleaner they are kept the more value they have. Next, a less amount of sweeping must be done around the machines. Sweeping not less often, but less time at each performance.

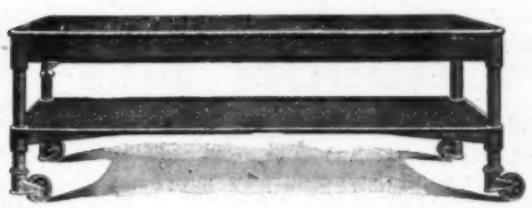


FIG. 2.

Also the floor will be in better condition to stand upon. Did you ever, when in a hurry, walk around with a steel shaving imbedded in the sole of a shoe which was none too thick anyhow? Try it some time and you will vote for some way to keep these shavings off the floor. It is almost needless to say anything about catching oil and soda water, not only to save them, but to keep the floor in respectable condition. The oil if necessary can be filtered and used over.

The two illustrations may be said to show the alpha and omega of lathe pans. The first is of a rough wooden trough, which in time becomes oil soaked, black and finally one end broken off, but still better than nothing. The other is a neat pan on castors, easily moved, easily cleaned, catching and retaining all the oil; finally a most convenient shelf for the chuck, steady-rest and other tools which often clutter up the floor at the end of the lathe. Both of these forms provide good toe room for the operator. Of course, between these extremes are intermediates, such as a wooden trough with sheet metal lining, an iron pan upon the floor, a pan hung from the bed which occasionally falls down, and many others. Since this is a method of saving and a convenience and comfort for the men, it is "up to" those in charge to start this economy. None of these pans are patented. There is no monopoly on them. If it is not wished to purchase them, they can be made in any shop. J. P. M.

Opposition to Piece Work Aims at Curbing Output.

In our last issue we printed a communication from the Christensen Engineering Co., of Milwaukee, replying to an inquiry concerning the strike of their men against the premium piece-work plan. In further discussion of the subject and by way of suggesting how the question is to be handled, the following letter from the same company will be found of interest to machine shop proprietors. None of them need be told that this question is the prime source of contention today between employers and machinists.

To the Editor:

"The possibility of success on the part of the employer in the endeavor to educate the mass of employes to a proper appreciation of the suicidal nature of the principle of artificial restriction of output and to prevent its encroachments, if resort is had only to argument and persuasion, is exceedingly problematic. We are forced to this conclusion by the fact that notwithstanding the machinists' union, under the signature of its officers, agreed to eliminate this principle, yet they have since gone on a strike to enforce it. And not only have they broken the agreement in regard to this feature, but have in addition ignored every promise and agreement made by them in that instrument. The provisions of the New York agreement are only just to the employer and are liberal in the extreme to the employe. If the unions will not live up to such an agreement from the sense of its justice and expediency, then a further motive must be supplied them. A combination of a large percentage of the employers bound together by a firm determination to insist upon the recognition by their employes of the principles of the New York agreement, whether formally accepted by the unions or not, and to resist any concerted action by a union against any member of the association (such action of the union being caused by employers insistence upon the terms of the agreement), by concerted action as drastic and far-reaching in relation to such union as are the measures adopted by the union to coerce a member, would be efficacious and in the long run more economical than any other means. In fact, such association and action appears to be the only possible method of destroying this imminent and fatal menace to the continued prosperity of the manufacturing industries of the Nation, with which prosperity the interest of the employe is even more intimately connected than that of the employer.

"There would be nothing in such action dangerous to the best interests of the workman. On a principle so important as this, employer and employe stand side by side and must lose or gain together, though in the aggregate the gain or loss according as the principle advocated by the unions is upheld or vanquished, will be greater to the employe than to the employer. Nothing but ignorance and temporary self-interest of incompetent or selfish leaders prevents the proper appreciation of this principle by the workingman."

British Trades Union Suppression of Labor-Saving Machinery.

British employers have been charged with apathy in regard to the introduction of special and labor-saving tools; and, as a matter of fact, until quite recently they have been far behind their competitors in America in the introduction and use of such tools. This backwardness, however, certain-

ly ought not to be charged entirely upon employers. The greater part of the responsibility for it rested with the trades unions and the application of their ideas by their members.

There has been no inducement to introduce automatic machines in Great Britain, because, at any rate, in many cases in which the attempt has been made, the members of the Amalgamated Society of Engineers have refused to permit such machines to be worked by any save members of their own society, and they themselves have refused to work more than one machine, although the automatic devices may have been specially intended to enable one man to work several; and they have also, whether of set purpose or through unwillingness to be taught, failed to get out of such tools anything like the amount of work that they were capable of producing.

It was, of course, useless for an employer to put in a very costly tool and then find that he had just as much to pay as before in wages for work done. This has not only prevented British employers from making use of such tools, but it has also prevented British tool makers from devising them, and from manufacturing and endeavoring to push them, so that today the British engineer who wishes to be abreast of the times in regard to labor-saving machinery finds himself, to a large extent, forced to go to America to purchase tools, though he would willingly buy the same tools in Great Britain were he able to do so.—[J. B. Alliott, in Cassier's Magazine for April.

INDUSTRIAL SUMMARY.

[If you are in need of machinery of any description, please notify *The Iron Trade Review*, and we will put you in communication with our advertisers at once.]

New Buyers in the Market and Some of Their Wants:

The Hooven, Owens & Rentschler Co. of Hamilton, O., will shortly be incorporated with a capital of $2,000,000, half common and half preferred. The increased capital is to provide for the enlargement of the present plant, and the construction of the Hamilton Corliss engine will be carried on on a more extensive basis than ever before. Since 1883 this company has been engaged in the exclusive manufacture of Corliss engines and since 1883 more than 4,000 have been built. The present officers of the company are J. C. Hooven, president; George A. Rentschler, vice-president; Henry Sohn, secretary and treasurer.

The Utility Water Supply Co. of Port Huron, Mich., has been incorporated with a capital of $25,000, and will engage in the manufacture of machinery and supplies for the use of pumping plants.

The Illinois Wire Co. of Chicago, Ill., has been incorporated with a capital of $10,000 to manufacture wire and wire products. George B. O'Reilly, W. L. Severin and W. S. Carpenter are the incorporators.

The State Line Metal Co., of Sioux City, Ia., has been incorporated with a capital of $50,000 by C. L. Wright, E. H. Hubbard and J. W. Hubbard.

Canton, O., is to have a new four-mill sheet plant to be known as the Stark Rolling Mill. It is to be built by the Berger Mfg. Co. A bonus of $6,000 and a suitable site will be contributed by the citizens of Canton.

The Standard Machine & Novelty Co. of Toledo, O., has been incorporated with a capital of $25,000. George W. Burchell, Phillip Metzgar, Henry C. Keller, Thomas F. Deck and Henry Shufeldt are the incorporators. The new concern will do a general machinery and repair business.

The Hardoin Brass Co. of Detroit, Mich., has been incorporated with a capital of $20,000. Nicholas Hardoin, C. M. Stevens and W. C. Stevens are the incorporators.

The Highland Iron & Steel Co. has been organized by Marion and Muncie, Ind., business men to operate a rolling mill at Terre Haute, Ind. The officers are Philip Matter, president; John L. Smith, vice-president, W. C. Ely, treasurer and manager; William Myers, secretary.

The Wilson-Pritchard Electric Co. of Niles, O., has been incorporated with a capital of $30,000. P. J. Pritchard, W. H. Pritchard, F. W. Stillwagon, H. W. Wiswell and C. M. Wilkins are the incorporators.

The Sturgess Governor Engineering Co. of Troy, N. Y., has been incorporated with a capital of $50,000 to manufacture turbine water wheel governors. John Sturgess, J. D. Ennis and E. R. Thomas are the incorporators.

The Southern Foundry Co. of Owensboro, Ky., has been incorporated with a capital of $40,000.

The Maryland Foundry & Machine Co. of Baltimore, Md., has been incorporated with a capital of $15,000. The concern will manufacture machinery and will carry on a general foundry business. Thomas P. Stran, Jr., Thomas F. Wilhelm, Charles T. Stran, Peter Gustavus and Albert H. Wehr are the incorporators.

The Popec Machine Co. of Lima, New York, has been incorporated with a capital of $30,000. E. D. Watkins, W. J. Coye and W. H. Hamlin are the incorporators.

The Dominion Wrought Iron Wheel Co. of Toronto, Can., has been incorporated with a capital of $20,000. Samuel Henderson, J. E. Knox and T. H. Knox are named as the provisional directors

The C. N. McKibben Mfg. Co. of Norwalk, Conn., has been incorporated with a capital of $15,000 to carry on the building of engines and to do general experimental work. George N. McKibben, William R. Thompson and Lewis H. Nash are the incorporators.

Fires and Accidents:—

The foundry of the New York Car Wheel Works at Buffalo, N. Y., was recently destroyed by fire entailing a loss of $100,000. Contracts have already been let for the reconstruction of the plant.

An over-heated core oven caused a $2,000 fire at the plant of the Belle City Malleable Iron Co., at Racine, Wis., recently.

A portion of the plant of the Boston Steel & Iron Co., located at Boston, Mass., was recently destroyed by fire; loss, $20,000.

Gordon & Brown's foundry and machine shop located at Moundsville, W. Va., was destroyed by fire last week with a loss of $9,000.

The machine shop owned by John F. Riley at Charleston, S. C., was destroyed by fire last week entailing a loss of $10,000.

The plant of the A. A. Griffing Iron Co. of Jersey City, N. J., was damaged to the extent of $75,000 by fire last week.

The Empire reaper and mower works of Seiberling, Miller & Co., at Doylestown, O., were destroyed by fire March 15. The loss is estimated at $50,000; insurance $20,000.

Fire destroyed the machine and blacksmith shop of the Cleveland Sawmill & Lumber Co., of Marquette, Mich.; insurance aggregates to $45,000.

The foundry of Mayer Bros., founders and machinists, at Mankato, Minn., was damaged by fire Feb. 23 to the extent of $3,186, which loss has been adjusted. The firm have purchased a larger site and are erecting a new foundry.

The hardware specialty factory of the Chicago Spring Butt Co., Chicago, burned down March 14. Loss, $100,000.

John F. Riley's machine shops, located at Charlestown, S. C., have been completely destroyed by fire; loss estimated at $10,000.

New Construction:—

Robinson & Co.'s threshing machine and engine factory at Richmond, Ind., will be considerably enlarged during the coming summer.

The Lloyd Booth Company of Youngstown, O., has awarded the contract for the construction of its new foundry to the American Bridge Co.

The Gordon Foundry & Machine Co., of St. Joseph, Mo., will shortly erect a new factory at an estimated cost of $10,000. The building will be 204 feet long and 40 feet wide.

Moore & White of Philadelphia have let contracts for the erection of a pattern shop to be 30x60 feet.

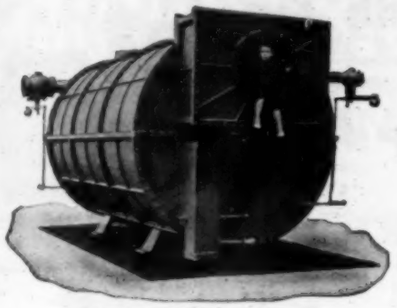
The Townley Metal Co. of Kansas City, Mo., will erect a $20,000 addition to its warehouse.

The Ornamental Iron & Wire Co. of Chattanooga, Tenn., is having plans prepared for an up-to-date plant.

The plant of the Sharon Steel Hoop Co. at Sharon, Pa., is to be practically doubled by the addition of two mills. One will be an 8-inch and the other a 12-inch mills.

E. M. Haubold will erect a $10,000 foundry at Harrison, Ark.

The new shops of the Pittsburg, Bessemer & Lake Erie rail-



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Special Design.

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FEED-WATER HEATER AND PURIFIER

after a duplex pump will give better results than a low pressure cylinder *after* a high pressure cylinder.

For the reason that, so long as the quantity of exhaust is not greater than is necessary to heat the water to 212°, all of the heat in the steam can be conserved—that is, saved and turned back into the boilers—whereas the low pressure cylinder only enables one to take advantage of the re-evaporation and of the little further expansion which occurs before the remainder of the steam passes into the condenser, from whence its heat is carried away and wasted through the condensing water.

As to why a "COCHRANE" will best answer for this service—it would be a pleasure to tell you, tho' we might add here that the Cochrane Heaters are well-designed appliances (since their design has been approved by many of the best known mechanical men in the country), built to withstand corrosion and pitting—and made particularly "easy to clean."

HARRISON SAFETY BOILER WORKS,
Clearfield & 17th Sts., - - - - Philadelphia, Pa.

road are to be located at Granville, Pa. The citizens of that town have donated a site of 20 acres of land.

The Union Steel Co., Pittsburg, which is building open hearth steel works, rod, wire and wire nail mills, at Donora, Pa., expects to have its plant in operation in the latter part of May.

The Cuyahoga Iron & Steel Co., recently organized at Cuyahoga Falls, O., with $100,000 capital stock, has already let the contract for its main building. It will be a 45x108 ft. frame structure with iron siding. The plant will be in operation about July 1, and will employ 75 men.

The Northern Pacific will make extensive additions to its St. Paul car shops, and will expend about $175,000 in enlarging the shops used for repairs to freight and passenger cars. Additions will also be made to the locomotive shops at Brainerd. The total expenditure will be about $4,500,000.

A tin plate mill employing 300 men will be built at the town of Lake, Milwaukee, if present negotiations are closed. John E. Jones, formerly superintendent of the Emlyn Iron Works of South Chicago, agrees to put up the plant in consideration of a bonus of $30,000 and 15 acres of land.

The Eclipse Mfg. Co. of Pittsburg, with a capital of $50,000, is building a small plant for the manufacture of steel forgings. The main building is to be 75x150 feet, and the company expects to begin operating about April 1.

Bovaird & Seyfang Mfg. Co., manufacturers of boilers, engines, etc., at Bradford, Pa., contemplates the rebuilding of its shops.

Revised bids for the construction of the large iron foundry for the Midvale Steel Works, at Nicetown, Pa., were submitted lately. The building will measure 250 feet by 61 feet 9 inches and will be three stories high.

As soon as the weather will permit, the Stoever Foundry & Mfg. Co. of Myerstown, Pa., will erect a large machine shop and enlarge its foundry so as to double its present capacity. The additions will be equipped with most improved appliances, the remainder being filled in as necessity requires. Besides their present specialty, boiler fronts and castings, they intend branching out into other lines of foundry work, also work in brass.

The Wm. Tod Co., Youngstown, O., has let the contract for the erecton of a new foundry. The steel frame building, which will be 125x250 feet, was given to the American Bridge Co., and will be turned out at the Youngstown works of that concern.

The King Bridge Co. of Cleveland recently completed improvements in its plant which increase the capacity fully one-third. The company recently entered into a contract with the Philadelphia Transit Company, Pa., for a number of street railway bridges and viaducts, costing about $250,000. Another large contract held by this company is for the construction of a double track cantilever bridge at the mouth of the Cuyahoga river, in Cleveland, for the Big Four railway.

F. R. Patch Mfg. Co., Rutland, Vt., has increased its floor space by an addition 16x82 to the foundry.

The Pittsburg District:—

Last week the H. K. Portor Co. of Pittsburg, builder of narrow guage locomotives, shipped an engine which bears the shop number of 2333. It is said that no other concern in the world building narrow guage locomotives has turned out so many.

Clark F. Rigby, formerly superintendent of the Pittsburg plant of the Oil Well Supply Co., and E. O. McCabe have organized the Rigby Manufacturing Co. and will erect a plant at Martinsville, W. Va., for the manufacture of oil well supplies. It will be a two-story plant, 50x100 feet.

Word has been received from the headquarters of the American Tin Plate Co. in New York to place the Monongahela plant, on the South Side, Pittsburg, in immediate operation.

Additions to the plant of the United States Seamless Tube Co., one of the plants of the National Tube Co., have been completed and the plant is now pronounced one of the best

The Robert Field Company,

20 Hayden Building, COLUMBUS, OHIO.

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"SLOSS," "FLORENCE," "LADY ENSLEY" AND "SHEFFIELD" brands of Alabama Foundry and Forge Pig Iron.

"GLOBE" the best Jackson County Ohio Silvery Softener.

"Alexandria," "Preston" and "Bessemer" Connellsville Foundry Coke.

"CLIMAX" Kanawha Foundry Coke. Smithing Coal.

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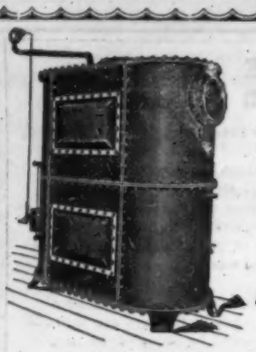

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FEED WATER HEATERS

Cut herewith illustrates Stilwell's latest design. Made entirely of cast iron. Saves fuel and filters the feed water for steam boilers. Use only exhaust steam.

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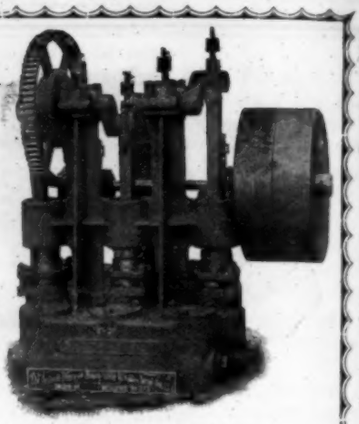

Triplex Boiler Feed Pump.

equipped seamless tube plants in the world. The cost of the installation of new machinery was $200,000 and more than 200 additional men will be given employment.

T. J. Johnston, of Sheffield, Ala., secretary and treasurer of the Sloss-Sheffield Steel & Iron Co., was in Pittsburg last week getting estimates on machinery for a new hoop and cotton tie plant which the company will add to its mills at Sheffield. The new plant is to have a capacity of 100 tons daily.

A special meeting of the Carborundum Co. of Niagara Falls will be held in Pittsburg on May 14 to readjust the finances of the company by issuing new bonds and also to increase the capital stock. The bonded indebtedness now is $75,000 of 6 per cent first mortgage bonds. It is intended to provide for this indebtedness and increase the bond issue to $400,000. Of the new issue $300,000 will be straight mortgage bonds bearing 5 per cent annually and $100,000 will be 10-year debenture bonds bearing 6 per cent interest. The bonds will probably be offered to the Pittsburg investing public. The capital stock is now $300,000, and at the same meeting it will be increased to $600,000.

The first annual meeting of the stockholders of the Carnegie Co. will be held at East Orange, N. J., on April 1. The annual election of the board of directors and officers of the company will take place at this meeting and much interest is already manifested in this event, owing to the organization of the United States Steel Co.

Chicago District and Northwest:—

Fraser & Chalmers are running their enlarged plant steadily 24 hours a day. One of the recent large orders secured is for the equipment of a large smelting plant, to be erected at Torreon, Mex., the machinery of which is to cost $125,000.

The F. P. Smith Wire & Iron Works, Chicago, have purchased from the American Steel and Wire Co. the Deering plant in that city, formerly the works of the Garden City Wire and Spring Co. the purchase price being $45,000.

Construction work has commenced on an addition to the power plant of the Chicago Edison Co., at Harrison street and the river, Chicago, at a cost of $60,000.

Raeder & Coffin have planned a $7,500 factory building to be erected for the Sullivan Machinery Co. in the northwest part of Chicago.

The capital stock of the Huron Iron Co., Chicago, Ill., has been increased from $50,000 to $300,000.

The Illinois Wire Co., Chicago, Ill., has been incorporated with a capital of $100,000 to manufacture wire and its products; incorporators, George B. O'Reilly, W. L. Severing, and William S. Carpenter.

An exhibition of automobiles will be held at the Coliseum building, Chicago, beginning next Saturday and lasting a week. All kinds of motor vehicles and accessories will be shown.

The American Steel & Wire Co. has sold 62 acres of unimproved land in South Chicago, Ill., fronting on the Calumet river to the Albert Dickinson Seed Co., the consideration exceeding, it is said, $160,000. The land was secured originally by the American Steel & Wire Co. from the Washburn & Moen Co.

The five-story brick plant of the Chicago Spring Butt Co., 497 Carroll avenue, Chicago, was destroyed by fire last week; loss, $70,000. The company manufactured hardware specialties.

The Price Machinery Co., Chicago, Ill., has been incorporated with a capital stock of $2,500 to engage in general manufacture; incorporators, L. D. Price, Grace N. Price, and Louis E. N. Branson.

General Industrial Notes:—

It is altogether probable that the tin plate plant of the American Tin Plate Co. at Johnstown, Pa., has been

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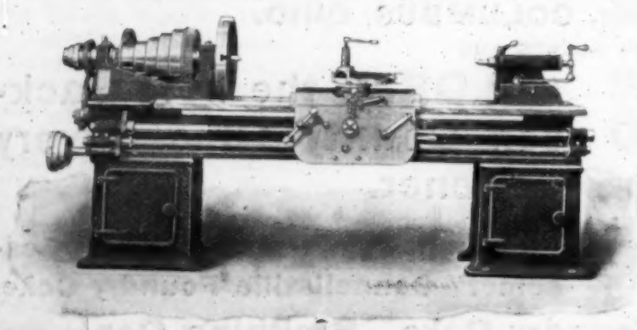

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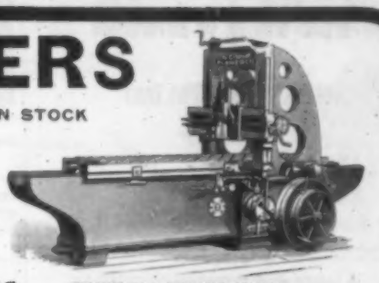

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abandoned by the consolidation as the men employed there have been requested to seek employment at the tin plant at Monessen, Pa.

The plant and business of the Toledo Bridge Co., located at Toledo, O., have been sold to the American Bridge Co. for $750,000.

The old Meadow rolling mill at Scottdale, Pa., controlled by the American Sheet Steel Co., will be placed into operation at once.

The Franklin Furnace at Clinton, N. Y., leased by M. A. Hanna & Co., is still idle and there is no promise of its again being placed in blast during the period of the present lease, which expires in July.

The first step on the part of the Pennsylvania Railroad Company toward the construction of steel cars in the Altoona, Pa., shops is the authorization of the building of 500 gondolas with a capacity of 80,000 pounds.

For the reorganization of the Diamond State Steel Co. it is proposed to issue $2,250,000 7 per cent preferred stock, $2,000,000 common stock at $10 a share and $1,000,000 4 per cent, 100 year, first-mortgage bonds. The bonds are to go to the Diamond State Iron Co. Of the $2,250,000 new preferred $375,000 is to be sold at par for cash with a bonus of common stock. The remaining $1,187,000 preferred stock and $1,500,000 common stock are to be exchanged for the present Diamond State Steel shares on the basis of 62 1-2 shares of the new full paid preferred and 50 shares of the full paid common shares for every 100 of the old $6.25 paid shares.

The Andover Iron Co. of Phillipsburg, N. J., whose furnaces located at Belvidere, N. J., have been in almost constant operation since 1848, is to be dissolved. Joseph Wharton of Philadelphia has purchased the entire stock of the concern and will continue the operation of the furnaces. The three principal stockholders in the original company were Peter Cooper, Edward Cooper and Abram S. Hewitt.

The Cherokee furnace at Cedartown, Ga., resumed operations last week after an idleness of several months. The nace was completely relined and otherwise improved.

The Cuyahoga Iron & Steel Co., recently organized at Cuyahoga Falls, O., has awarded the contracts for the erection of

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its new plant. The main building will be 45x180 feet. All the equipment has been contracted for and it is expected that the plant will be in operation in July.

The E. P. Allis Co.'s engine works at Milwaukee, Wis., booked a large number of orders during the month of February. In fact it is stated that this month was one of the best in the history of the company. The orders included one from the American Steel Wire Co.'s Cleveland works for one combined vertical and horizontal rolling mill engine with cylinders 40 and 80 by 60. The Witherbee-Sherman Co. of Mineville, N. Y., ordered one 1890 tandem compound engine and condenser.

The new buildings to replace the plant of Fairbanks & Timm's machine shop at Appleton, Wis., recently destroyed by fire, are completed and most of the machinery is placed.

The Filer & Stowell Co., of Milwaukee, Wis., has recently booked the following orders: One 2,500-h. p. tandem compound engine for Wilmot & Hobbs, Bridgeport, Conn.; 500-h. p. compound engine for Mishiwaki Milling Co.; 150-h. p. engine for Bridgeport, Holliston & Farmington Street Railway of Massachusetts, and one 3,000-h. p. horizontal cross-compound direct connected tandem for the Rhode Island Suburban railway of Providence, R. I.

Wilson P. Hunt, who has been employed for the past seven years by the Deere & Mansur Co., of Moline, Ill., has purchased the machinery and tangible property of the Moline Pattern & Machine Works, owned and managed by D. A. Gamble. With the transfer the incorporated company known as the Moline Pattern & Machine Works goes out of existence and the works will be operated under the name of the Moline Tool Co., making a specialty of manufacturing special machinery.

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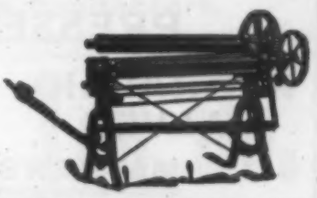

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James M. Swank, author of "Iron in All Ages," and editor of the *Bulletin* of The American Iron & Steel Association, in reviewing "Metallurgy of Cast Iron," says it is "One of the most valuable publications relating to the manufacture of iron castings, that has ever, to our knowledge been issued in this or any other country."

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The methods for analysis of iron ore, iron and steel and for assaying have been given briefly, but perhaps as much in detail as is consistent with the general scope of the book. Several changes and additions to the Specific Gravity tables have been made by adoption of later and more accurate values.

In the notes on blast furnace practice have been outlined the more important theoretical and practical points, which, it is hoped, will be of some service to those interested in the manufacture of iron.

The hygrometric table gives the necessary information for determining the amount of moisture in air, a subject whose importance in metallurgical operations is being more fully recognised at present than heretofore. This table is new and is based on the most accurate data available at the present time.

The tables of weights and measures, United States and foreign, have been very much amplified, and the conversion tables for United States and metric weight and measures of the U. S. Coast and Geodetic Survey included, the latter being based on the legal standard for this country.

Numerous miscellaneous tables have been added, which, it is hoped, will be found of value

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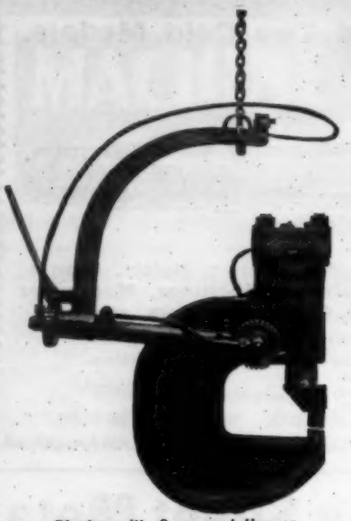

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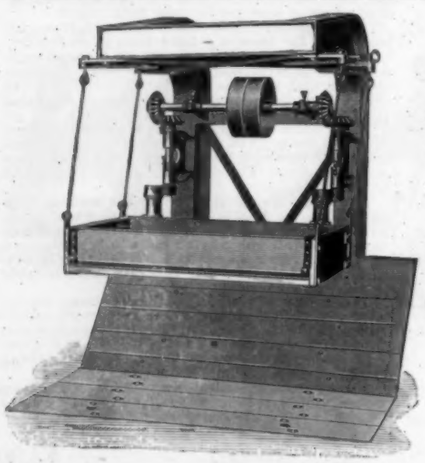

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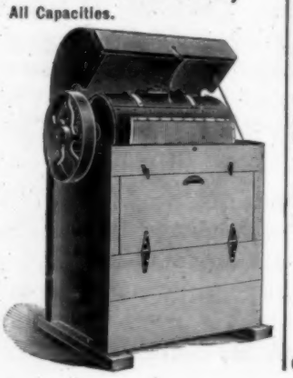

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From the circular of the Association, issued under date of Sept. 15 we take the following:

"In March last we presented to the American Iron Trade a descriptive list of the consolidations of iron and steel companies which had taken place in the United States since January 1, 1898, twenty-three in all. We now present to the trade a more complete list of iron and steel consolidations, embracing those organized since March as well as those previously described, *numbering thirty in all*, the information relating to each consolidated company being revised and verified down to August 15. We have confined the list of consolidations to those which embrace the ownership of blast furnaces, rolling mills, steel works, tinplate works, and auxiliary industries, including shipbuilding and bridgebuilding works. Only companies that have been consolidated since January 1, 1898, are described in this volume, which is a Supplement to the last edition of our Directory to the Iron and Steel Works of the United States. *A new edition of the Directory cannot be printed this year.*

"The present edition of the Supplement comprises 78 well printed pages and contains an authorized description of the organization of each of the thirty consolidations mentioned, giving its capitalization, list of officers, general office address and address in most instances of the district offices, and a list of properties owned or operated by it, with the names of previous owners of iron and steel works. The name and the character of every plant are fully stated. For detailed information concerning the plants mentioned and their products reference is given to the page or pages in the Directory in which they are fully described. Iron ore mines, coal mines, coke ovens, railroads, and lake vessels owned by the consolidated companies are also given in sufficient detail."

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15	13	11	Lorain Branch	10	14	16
P.M.	P.M.	A.M.		P.M.	A.M.	P.M.
4:00	1:05	7:00	Lorain	3:32	12:02	7:15
4:18	1:25	7:20	Elyria.....	3:14	11:45	6:59
4:36	1:53	7:43	Grafton	2:56	11:20	6:41
4:58	2:15	8:05	Lester Jun....	2:32	11:08	6:21

5	3	1	Main Line.	2	4	6
P.M.	P.M.	A.M.		A.M.	A.M	P.M.
5:10	1:35	7:50	Cleveland.....	9:50	12:00	6:00
6:20	2:31	8:27	Lester Jun..	8:48	11:07	5:00
6:31	2:40	8:36	Medina	8:36	1 :59	4:48
6:54	2:59	8:57	Seville	8:14	10:40	4:26
7:00	3:04	9:03	Sterling	8:03	10:34	4:20
7:22	3:24	9:24	Warwick.....	7:41	10:13	3:56
7:30	3:32	9:31	Canal Fult'n	7:34	10:06	3:48
7:50	3:50	9:50	Ar. Dep Massillon.	7:15 8 P.M	9:50	3:30
7:50	3:50	9:50	Dep. Ar.	7:50	9:50	3:30
8:05	4:06	10:05	Justus.....	7:31	9:35	3:13
8:35	4:37	10:36	Canal Dover	7:03	9:05	2:44
8:42	4:44	10:43	New Phila....	6:55	8:58	2:37
9:00	5:01	11:00	Ar. Dep Urichsville	6:38	8:40	2:20
7:30 A.M.	5:10	11:10	Dep. Ar	6:38	8:40	2:20
8:06	5:43	11:42	Freeport	6:00	8:06	1:44
		P.M.				
8:32	6:07	12:05	Flushing	5:34	7:42	1:20
9:40	7:05	1:05	Bridgeport....	4:30	6:45	12:20

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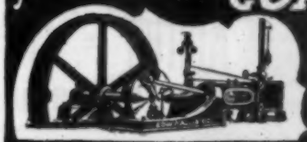

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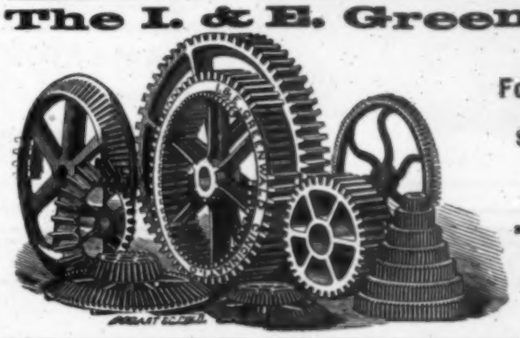

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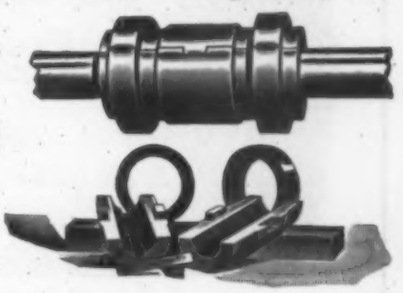

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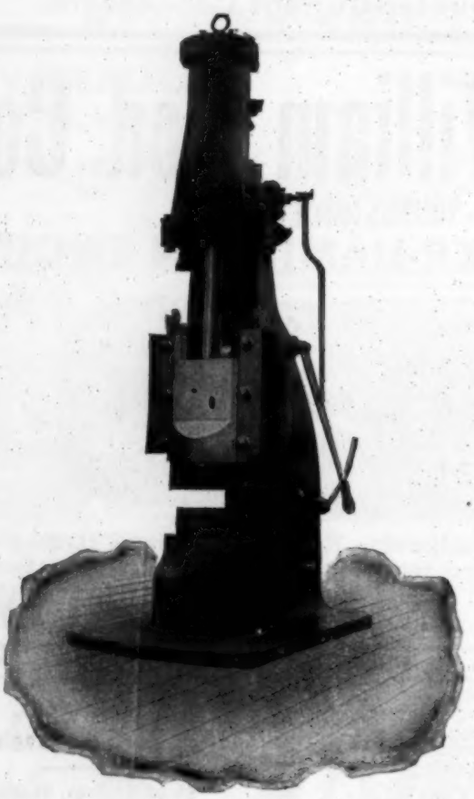

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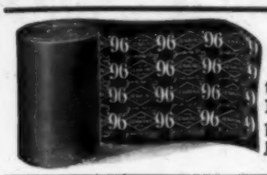

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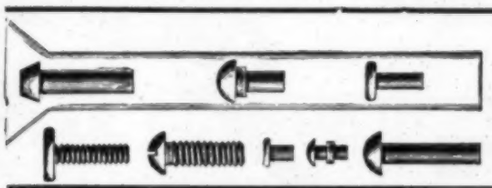

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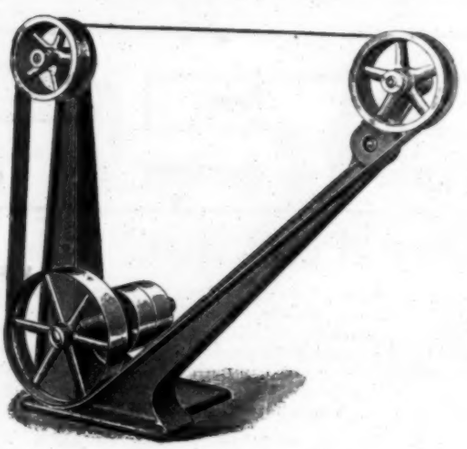

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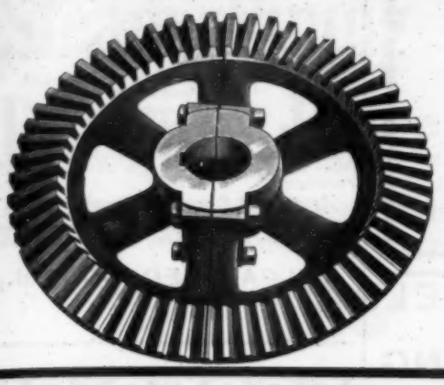

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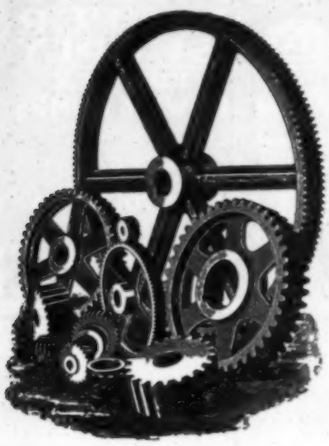

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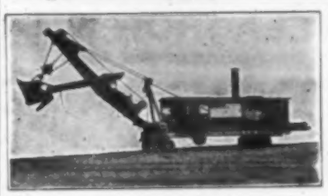

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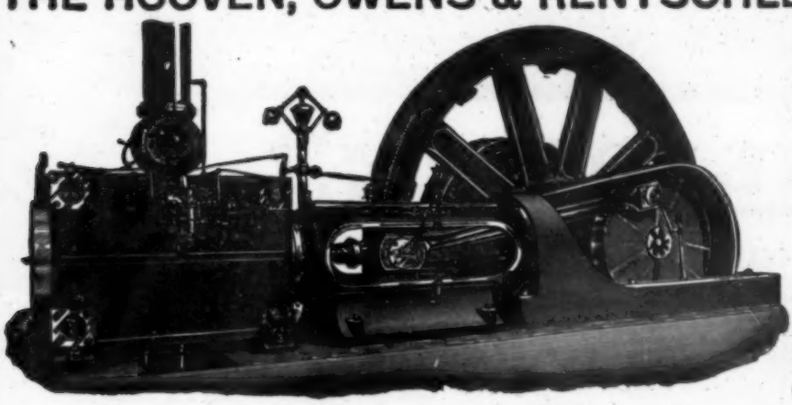

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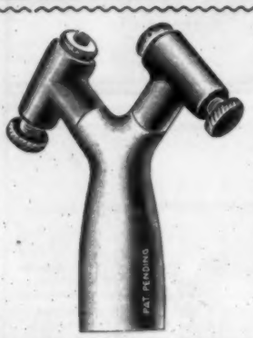

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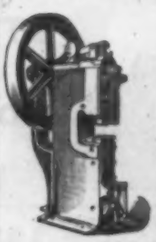

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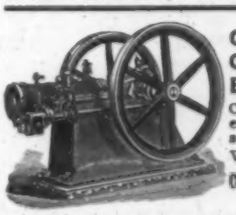

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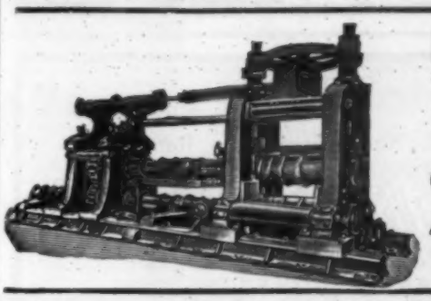

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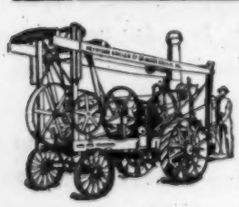

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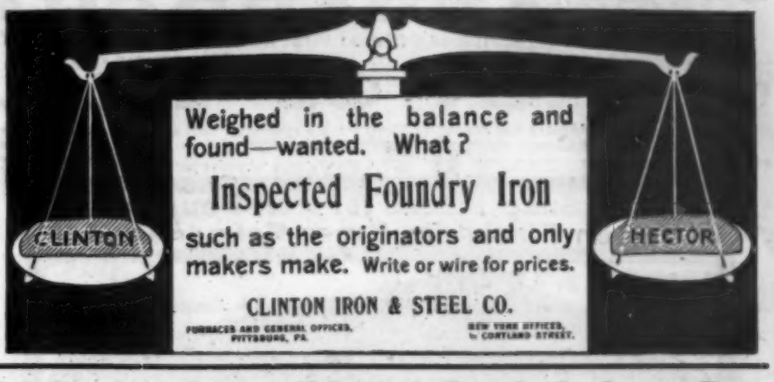
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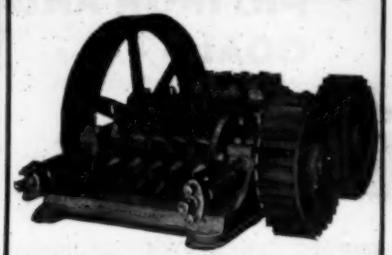

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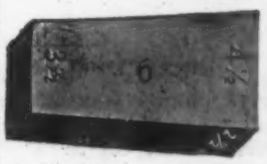

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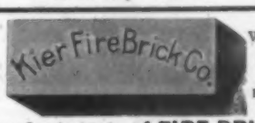

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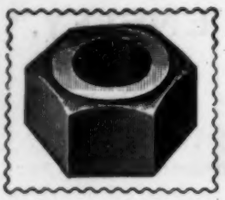

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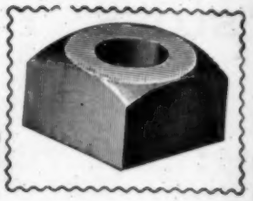

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Brass Founders' Supply Co., Newark, N. J.
Hooven, Owens & Rentschler Co., Hamilton, O.
Jeffrey Manufacturing Co., Columbus, O.
W. A. Jones Foundry Co., Chicago, Ill.
Link Belt Machinery Co., Chicago, Ill.
Massillon Iron & Steel Co., Chicago, Ill.
Lorain Foundry Co., Lorain, O.
Geo. B. Sennett Co., Youngstown, O.
Seaman-Sleeth Co., Pittsburg, Pa.
Vincent Valve Co., Sandusky, O.
Wheeling Mold & Foundry Co., Wheeling, W. Va.
West Penn Foundry & Machine Co., Avonmore, Pa.

CASTINGS (ALUMINUM)—
J. J. Ryan & Co., Chicago, Ill.

CASTINGS (BRASS)—
The Best Manufacturing Co., Pittsburg, Pa.
Lorain Foundry Co., Lorain, O.
The Lunkenheimer Co., Cincinnati, O.
J. J. Ryan & Co., Chicago, Ill.
Vincent Valve Co., Sandusky, O.

CASTINGS (BRONZE)—
The Best Mfg. Co., Pittsburg, Pa.
Lorain Foundry Co., Lorain, O.
J. J. Ryan & Co., Chicago, Ill.
The Lunkenheimer Co., Cincinnati, O.

CASTINGS (MALLEABLE)—
Acme Steel & Malleable Iron Works, Buffalo.
Meadville Malleable Iron Co., Meadville, Pa.

CASTINGS (STEEL)—
Acme Steel & Malleable Iron Works, Buffalo.
Bethlehem Steel Co., South Bethlehem, Pa.
Otis Steel Co., Cleveland, O.
The Sargent Co., Chicago, Ill.

CAULKING HAMMERS—
Cleveland Pneumatic Tool Co., Cleveland, O.
Chicago Pneumatic Tool Co., Chicago, Ill.

CEMENT—
Reed F. Blair & Co., Pittsburg, Pa.
Garden City Sand Co., Chicago, Ill.

CHAIN—
Standard Chain Co., Pittsburg, Pa.
Somers, Fitler & Clarke, Pittsburg, Pa.

CHAIN BELTING—
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Machinery Co., Chicago, Ill.
The Aultman Co., Canton, O.

CHANNELERS—
The Ingersoll-Sergeant Drill Co., New York.

CHANNELS—
American Steel Hoop Co., New York City.

CHEMISTS—
Geo. C. Davis, Philadelphia, Pa.
F. A. Emmerton, Cleveland, O.
Grasselli Chemical Co., Cleveland, O.
The R. W. Hunt & Co., Chicago, Ill.
O. Texter, Cleveland, O.

CHILLED AND SAND ROLLS—
Canton Roll & Machine Co., Canton, O.
Frank-Kneeland Machine Co., Pittsburg, Pa.
A. Garrison Foundry Co., Pittsburg, Pa.
Lorain Foundry Co., Lorain, O.
Seaman, Sleeth Co., Pittsburg, Pa.
Wm. Tod & Co., Youngstown, O.
Totten & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
West Penn Foundry & Machine Co., Avonmore, Pa.

CHIPPING HAMMERS—
Cleveland Pneumatic Tool Co., Cleveland, O.
Chicago Pneumatic Tool Co., Chicago, Ill.

CHUCKS—
Somers, Fitler & Clarke, Pittsburg, Pa.

COAL CARS—
American Engineering Works, Chicago, Ill.
Pressed Steel Car Co., Pittsburg, Pa.

COAL CUTTERS—
The Ingersoll-Sergeant Drill Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Link Belt Machinery Co., Chicago, Ill.

COAL SCREENS—
Rob't Aitchinson Per. Metal Co., Chicago, Ill.
The Aultman Co., Canton, O.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus, O.
Western Machinery & Supply Co., Chicago, Ill.

COAL AND COKE—
Alabama Consolidated Coal & Iron Co., Birmingham, Ala.
Amyville-Youghiogheny Gas Coal Co., Pittsburg, Pa.
Bessemer Coke Co., Pittsburg, Pa.
Reed F. Blair & Co., Pittsburg, Pa.
Cherry Valley Iron Co., Pittsburg, Pa.
A. M. Crane & Co., Chicago, Ill.
Crerar Clinch & Co., Chicago, Ill.
H. C. Frick Coke Co., Pittsburg, Pa.
The Rob't Field Co., Columbus, O.
O'Gara, King & Co., Chicago, Ill.
M. A. Hanna & Co., Cleveland, O.
J. H. Hillman & Son, Pittsburg, Pa.
Jerome Keeley & Co., Philadelphia, Pa.
McKeefrey & Co., Leetonia, O.
Pilling & Crane, Philadelphia, Pa.
Pickand, Brown & Co., Chicago, Ill.
Pickands, Mather & Co., Cleveland, O.
Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.

COAL HANDLING MACHINERY—
The Atlas Car & Mfg. Co., Cleveland, O.
A. Leschen & Sons Rope Co., St. Louis, Mo.

COAL MINING MACHINERY—
Exeter Machine Works, Pittston, Pa.
Jeffrey Mfg. Co., Columbus, O.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Link Belt Machinery Co., Chicago, Ill.
Webster, Camp & Lane Machine Co., Akron, O.

COLD SAWS—
J. R. Vandyck, New York City, N. Y.

COMPAROMETERS—
Vulcan Mfg. Co., Pittsburg, Pa.

COMPRESSION COUPLINGS—
The Aultman Co., Canton, O.
Geo. B. Sennett Co., Youngstown, O.

CONDENSERS—
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

CONTRACTORS' SUPPLIES—
A. Leschen & Sons Rope Co., St. Louis, Mo.

CONVEYING MACHINERY—
American Engineering Works, Chicago, Ill.
Exeter Machine Works, Pittston, Pa.
A. Leschen & Sons Rope Co., St. Louis, Mo.

CONVEYORS—
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Machinery Co., Chicago, Ill.
The Aultman Co., Canton, O.
The Brown Hoisting Machinery Co., Cleveland.
Webster Camp & Lane Machine Co., Akron, O.

COPPER GASKETS—
Drake Acetylene Apparatus Co., Cleveland, O.

CORE OVENS—
Millett Core Oven Co., Brightwood, Mass.

CORRESPONDENCE SCHOOLS—
International Correspondence Schools, Scranton, Pa.

CORRUGATED IRON—
Berger Mfg. Co., Canton, O.
Wm. B. Scaife & Sons, Pittsburg, Pa.
American Sheet Steel Co., New York City.

COTTON TIES—
American Steel Hoop Co., New York City.
American Steel & Wire Co., Chicago, Ill.

CRANES—
Atlas Machine Co., Pittsburg, Pa.
The Brown Hoisting Machinery Co., Cleveland.
The Bucyrus Co., South Milwaukee, Wis.
Cleveland Crane & Car Co., Cleveland, O.
Cleveland Punch & Shear Wks. Co., Cleveland.
Northern Engineering Works, Detroit, Mich.
S. Obermayer Co., Cincinnati, O., and Chicago.
Marion Steam Shovel Co., Marion, O.
Torbert & Peckham, Chicago, Ill.
R. D. Wood & Co., Philadelphia, Pa.
Wm. Tod & Co., Youngstown, O.

CRANES AND DERRICKS—
A. Leschen & Sons Rope Co., St. Louis, Mo.

CRANK PINS—
Bethlehem Steel Co., S. Bethlehem, Pa.

CRUSHING MACHINERY—
Raymond Bros. Impact Pulverizer Co., Chicago.

CUPOLAS—
Riter-Conley Mfg. Co., Pittsburg, Pa.
Northern Engineering Works, Detroit, Mich.
Wm. B. Pollock Co., Youngstown, O.
S. Obermayer Co., Cincinnati, O., and Chicago, Ill.
The United Boiler Co., Girard, O.

DECALCOMANIAS—
Scientific Manufacturing Co., Chicago, Ill.

DIES—
American Steel & Wire Co., Chicago, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Danielson Machine & Tool Co., Cleveland, O.
Gearing & Hoerle, Allegheny, Pa.

DIE STOCKS—
Curtis & Curtis Co., Bridgeport, Conn.

DREDGES—
Marion Steam Shovel Co., Marion, O.
The Bucyrus Co., South Milwaukee, Wis.
The Jeffrey Mfg. Co., Columbus, O.
Thew Automatic Shovel Co., Lorain, O.

DRILL GRINDERS—
J. Wendell Cole, Columbus, O.
Somers, Fitler & Clarke, Pittsburg, Pa.

DRILLING MACHINERY—
Keystone Driller Co., Beaver Falls, Pa.

DRILL PRESSES—
C. H. Besly & Co., Chicago, Ill.
Jos. E. Bissell, Agt. Prentiss Tool & Supply
U. Baird Machinery Co., Pittsburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland.
Bickford Drill & Tool Co., Cincinnati, O.
Danielson Machine & Tool Co., Cleveland, O.
Co., Pittsburg, Pa.
Somers, Fitler & Clarke, Pittsburg, Pa.

DROP FORGINGS—
E. D. Clapp Mfg. Co., Auburn, N. Y.
Chicago Drop Forge & Foundry Co., Kensington, Ill.
Jas. H. Baker Mfg. Co., Pittsburg, Pa.
Frankford Steel & Forging Co., Philadelphia.
Wyman & Gordon, Worcester, Mass.

DROP HAMMERS—
Cleveland Punch & Shear Wks. Co., Cleveland.

DROP PRESSES—
Avery Stamping Co., Cleveland, O.
Bethlehem Fdry & Mach. Co., Bethlehem, Pa.
Bertsch & Co., Cambridge City, Ind.
C. H. Besly & Co., Chicago, Ill.
Cleveland Punch & Shear Wks. Co., Cleveland.
Danielson Machine & Tool Co., Cleveland, O.

DYNAMOS—
Bullock Electric Mfg. Co., Cincinnati, O.
Jeffrey Mfg. Co., Columbus, O.

EAVE TROUGHS AND CONDUCTORS—
Berger Mfg. Co., Canton, O.

ELECTRICAL MACHINERY & SUPPLIES—
Bullock Electric Mfg. Co., Cincinnati, O.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Pelton Engineering Co., Cleveland, O.

ELECTRICAL WIRES AND CABLES—
American Steel & Wire Co., Chicago, Ill.

ELEVATING AND CONVEYING MACHINERY—
American Engineering Works, Chicago, Ill.
The Aultman Co., Canton, O.
American Engineering Works, Chicago, Ill.
The Brown Hoisting Machinery Co., Cleveland, O.
Exeter Machine Works, Pittston, Pa.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Machinery Co., Chicago, Ill.
Lidgerwood Mfg. Co., New York City.
Webster Camp & Lane Machine Co., Akron, O.

EMERY AND CORUNDUM WHEELS—
C. H. Besly & Co., Chicago, Ill.
J. Wendell Cole, Columbus and Chicago.
Northampton Emery Wheel Co., Chicago, Ill.
Somers, Fitler & Clarke, Pittsburg, Pa.

EMERY WHEEL MACHINERY—
C. H. Besly & Co., Chicago, Ill.
J. Wendell Cole, M. E., Columbus, O., or Chicago.
Northampton Emery Wheel Co., Chicago, Ill.

ENGINEERS AND CONTRACTORS—
American Engineering Works, Chicago, Ill.
Alex. Laughlin & Co., Pittsburg, Pa.
The Best Manufacturing Co., Pittsburg, Pa.
E. E. Erickson, Pittsburg, Pa.
Garrett-Cromwell Engineering Co., Cleveland.
Jeffrey Mfg. Co., Columbus, O.
Julian Kennedy, Pittsburg, Pa.
David Lamond, Pittsburg, Pa.
Meehan Boiler & Construction Co., Lowellville.
Pittsburg Valve, Foundry & Construction Co., Pittsburg, Pa.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Wellman-Seaver Engineering Co., Cleveland, O
Walter Kennedy, Pittsburg, Pa.

ENGINE PACKING—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.

ENGINEERS' SUPPLIES—
C. H. Besly & Co., Chicago, Il.
Jenkins Bros., New York City.
The Lunkenheimer Co., Cincinnati, O.
Drake Acetylene Apparatus Co., Cleveland, O.
Wright Mfg. Co., Cleveland, O.

ENGINE LATHES—
U. Baird Machinery Co., Pittsburg, Pa.
Jos. E. Bissell, Agt. Prentiss Tool & Supply Co., Pittsburg, Pa.
Somers, Fitler & Clarke, Pittsburg, Pa.

ENGINES (OIL) —
The Aultman Co., Canton, O.

ENGINES (STEAM)—
The Aultman Co., Canton, O.
The Edward P. Allis Co., Milwaukee, Wis.
The Hooven, Owens & Rentschler Co., Hamilton, O.
Somers, Fitler & Clarke, Pittsburg, Pa.
The Wm. Tod Co., Youngstown, O.
Wickes Bros., Pittsburg, Pa.

ENGRAVERS AND ELECTROTYPERS—
Rosenow & Co., Chicago, Ill.

FEED WATER HEATERS AND PURIFIERS—
Austin Separator Co., Detroit, Mich.
Harrison Safety Boiler Works, Philadelphia.
Wm. B. Scaife & Sons, Pittsburg, Pa.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

FELLOE PLATES—
Avery Stamping Co., Cleveland, O.

FILES, MAKERS OF—
C. H. Besly & Co., Chicago, Ill.

FILTER PRESSES—
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

FILTERS—
Pittsburg Filter Mfg. Co., Pittsburg, Pa.
Wm. B. Scaife & Sons, Pittsburg, Pa.

FIRE BRICK AND CLAY—
Chicago Fire Brick Co., Chicago, Ill.
Clearfield Fire Brick Co., Clearfield, Pa.
Crown Fire Clay Co., Akron, O.
Dover Fire Brick Co., Cleveland, O.
John H. Ehlen, Newport, Ky.
Garden City Sand Co., Chicago, Ill.
A. J. Hawes & Son, Johnstown, Pa.
F. B. Holmes & Co., Detroit, Mich.
Kentucky Fire Brick Works, Portsmouth, O.
Keystone Fire Clay Co., Lisbon, O.
Kier Fire Brick Co., Pittsburg, Pa.
Oak Hill Fire Brick & Coal Co., Oak Hill, O.
S. Obermayer Co., Cincinnati, O., and Chicago.
Reese-Hammond Fire Brick Co., Bolivar, Pa.
J. V. Rose & Son, Sharon, Pa.
F. B. Stevens, Detroit, Mich.
Scioto Star Fire Brick Works, Portsmouth, O.
A. F. Smith & Co., New Brighton, Pa.
Scioto Fire Brick Co., Sciotoville, O.
Union Mining Co., Mt. Savage, Md.
Solon J. Vlasto, New York City.
Webster Fire Brick Co., South Webster, O.

FIRE PROOF COVERING—
C. H. Besley & Co., Chicago, Ill.
Somers, Fitler & Clarke, Pittsburg, Pa.

FOOT AND POWER LATHES—
U. Baird Machinery Co., Pittsburg, Pa.

FORGINGS—
Jas. H. Baker Mfg. Co., Pittsburg, Pa.
Bethlehem Steel Co., South Bethlehem, Pa.
Chicago Drop Forge & Foundry Co., Kensington, Ill.
E. D. Clapp Mfg. Co., Auburn, N. Y.
Cleveland City Forge & Iron Co., Cleveland, O
Frankford Steel & Forging Co., Philadelphia.
Wyman & Gordon, Worcester, Mass.
Danielson Machine & Tool Co., Cleveland, O.
Samuel Trethewey & Co., Pittsburg, Pa.
Geo. B. Sennett Co., Youngstown, O.
Pilling & Crane, Philadelphia, Pa.
Vulcanus Forging Co., Cleveland, O.

FOUNDRIES—
E. R. Allen, Corning, N. Y.
The Aultman Co., Canton, O.
Best Manufacturing Co., Pittsburg, Pa.
Brass Founders' Supply Co., Newark, N. J.
Hooven, Owens & Rentschler Co., Hamilton, O.
Jeffrey Mfg. Co., Columbus, O.
W. A. Jones Foundry Co., Chicago.
Link Belt Machinery Co., Chicago, Ill.
Pittsburg Valve, Foundry & Construction Co., Pittsburg, Pa.
Seaman, Sleeth Co., Pittsburg, Pa.
Wm. Tod & Co., Youngstown, O.
Wheeling Mold and Foundry Co., Wheeling, W. Va.

FOUNDRY EQUIPMENT—
Jos. E. Bissell, Agt. Prentiss Tool & Supply
Brass Founders' Supply Co., Newark, N. J.
Cleveland Crane & Car Co., Cleveland, O.
Co., Pittsburg, Pa.
Chicago Pneumatic Tool Co., Chicago, Ill.
Macleod & Clark, Cincinnati, O.
Millett Core Oven Co., Brightwood, Mass.
Northern Engineering Works, Detroit, Mich.
S. Obermayer Co., Cincinnati, O., and Chicago.
Tabor Mfg. Co., Philadelphia, Pa.
Vulcan Mfg. Co., Pittsburg, Pa.

FOUNDRY FACINGS—
Cleveland Facing Mill Co., Cleveland, O.
S. Obermayer Co., Cincinnati, O., and Chicago.

FOUNDRY SUPPLIES—
Brass Founders' Supply Co., Newark, N. J.
Clearfield Fire Brick Co., Clearfield, Pa.
Cleveland Crane & Car Co., Cleveland, O.
John H. Ehlen, Newport, Ky.
Cleveland Facing Mill Co., Cleveland, O.
Chicago Fire Brick Co., Chicago, Ill.
Crown Fire Clay Co., Akron, O.
Dover Fire-Brick Co., Cleveland, O.
Garden City Sand Co., Chicago, Ill.
A. J. Haws & Son, Johnstown, Pa.
F. B. Holmes & Co., Detroit, Mich.
Kentucky Fire Brick Works, Portsmouth, O.
Keystone Fire Clay Co., Lisbon, O.
Kier Fire Brick Co., Pittsburg, Pa.
Millett Core Oven Co., Brightwood, Mass.
Newport Sand Bank Co., Newport, Ky.
Northern Engineering Works, Detroit, Mich.
Oak Hill Fire Brick & Coal Co., Oak Hill, O.
S. Obermayer Co., Cincinnati, O., and Chicago.
The Ohio Sand Co., Conneaut, O.
Reese-Hammond Fire Brick Co., Bolivar, Pa.
J. V. Rose & Son, Sharon, Pa.
Scioto Fire Brick Co., Sciotoville, O.
Somers, Fitler & Clarke, Pittsburg, Pa.
A. F. Smith & Co., New Brighton, Pa.
F. B. Stevens, Detroit, Mich.
Scioto Star Fire Brick Works, Portsmouth, O.
Tabor Mfg. Co., Philadelphia, Pa.
Union Mining Co., Mt. Savage, Md.
Solon J. Vlasto, New York City.
Vulcan Mfg. Co., Pittsburg, Pa.
Webster Fire Brick Co., South Webster, O.
Webster Foundry Sand Co., Philadelphia, Pa.

FRICTION METAL—
C. H. Besly & Co., Chicago, Ill.
Theo. Hiertz & Son, St. Louis, Mo.
J. J. Ryan & Co., Chicago, Ill.

FURNACE LININGS—
Union Mining Co., Mt. Savage, Md.

FUEL OIL BURNERS—
Rockwell Engineering Co., New York City.

GAGE COCKS—
The Lunkenheimer Co., Cincinnati, O.

GALVANIZED IRON—
American Sheet Steel Co., New York City.
McCullough Iron Co., Wilmington, Del.

GALVANIZERS—
American Sheet Steel Co., New York City.

GALVANIZING POTS—
The Wm. B. Pollock Co., Youngstown, O.

GAS ENGINES—
Atlas Machine Co., Pittsburg, Pa.
Columbus Machine Co., Columbus, O.
Miller Improved Gas Engine Co., Springfield.
Northern Engineering Works, Detroit, Mich.
Somers, Fitler & Clarke, Pittsburg, Pa.

GAS PRODUCERS—
R. D. Wood & Co., Philadelphia, Pa.

GEARING—
James Bonar & Co., Pittsburg, Pa.
F. H. Bultman & Co., Cleveland, O.
Fraser & Chalmers, Chicago, Ill.
The Van Dorn & Dutton Co., Cleveland, O.
I. & E. Greenwald Co., Cincinnati, O.
Link Belt Machinery Co., Chicago, Ill.
National Gear Wheel & Foundry Co., Allegheny, Pa.
The R. D. Nuttall Co., Allegheny, Pa.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

GEAR CUTTERS—
F. H. Bultman & Co., Cleveland, O.

GEAR CUTTING—
F. H. Bultman & Co., Cleveland, O.
The Van Dorn & Dutton Co., Cleveland, O.
The R. D. Nuttall Co., Allegheny, Pa.

GEAR LUBRICANTS—
The Ironsides Company, Columbus, O.
Wisconsin Graphite Co., Pittsburg, Pa.

GIRDER WORK—
Wm. B. Scaife & Sons, Pittsburg, Pa.

GRINDING MACHINERY—
Raymond Bros. Impact Pulverizer Co., Chicago.

GRAPHITE PAINT—
Wisconsin Graphite Co., Pittsburg, Pa.

GRINDSTONES—
C. H. Besly & Co., Chicago, Ill.

GRAPHITE PAINT—
Jos. Dixon Crucible Co., Jersey City, N. J.

HACK SAWS—
Cleveland Punch & Shear Wks. Co., Cleveland

HANGERS—
The Aultman Co., Canton, O.
E. A. Delano, Chicago, Ill.
I. & E. Greenwald Co., Cincinnati, O.
Dodge Mfg. Co., Mishawaka, Ind.
Link Belt Machinery Co., Chicago, Ill.
Somers, Fitler & Clarke, Pittsburg, Pa.

HARNESS SNAPS—
Covert Mfg. Co., West Troy, N. Y.

HEATERS AND PURIFIERS—
Austin Separator Co., Detroit, Mich.
Harrison Safety Boiler Works, Philadelphia.
The United Boiler Co., Girard, O.

HEAVY HARDWARE—
C. H. Besly & Co., Chicago, Ill.

HOISTS—
The Aultman Co., Canton, O.
Lidgerwood Mfg. Co., New York City.

HOISTING ENGINES—
The Aultman Co., Canton, O.
The Edward P. Allis Co., Milwaukee, Wis.
Exeter Machine Works, Pittston, Pa.
Lidgerwood Mfg. Co., New York City.
Somers, Fitler & Clarke, Pittsburg, Pa.
Torbert & Peckham, Chicago, Ill.
Webster, Camp & Lane Machine Co., Akron, O.

HOISTING MACHINERY—
The Aultman Co., Canton, O.
The Brown Hoisting Machinery Co., Cleve
Exeter Machine Works, Pittston, Pa.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Link-Belt Machinery Co., Chicago, Ill.
Jeffrey Mfg. Co., Columbus, O.
Lidgerwood Mfg. Co., New York City.
land, O.
Webster, Camp & Lane Machine Co., Akron, O.

HOISTING ROPE (WIRE)—
American Steel & Wire Co., Chicago, Ill.

HOOPS (STEEL)—
American Steel Hoop Co., New York City.

HORSE SHOES—
American Steel & Wire Co., Chicago, Ill.
Phoenix Horse Shoe Co., Joliet, Ill.

HYDRAULIC TOOLS—
R. D. Wood & Co., Philadelphia, Pa.

INDUSTRIAL CARS—
American Engineering Works, Chicago, Ill.
The Atlas Car & Mfg. Co., Cleveland, O.
The Pressed Steel Car Co., Pittsburg, Pa.

INGOT MOLDS—
Lorain Foundry Co., Lorain, O.

INJECTORS—
C. H. Besly & Co., Chicago, Ill.
The Lunkenheimer Co., Cincinnati, O.
Somers, Fitler & Clarke, Pittsburg, Pa.

INSURANCE COMPANIES—
Hartford Steam Boiler I. & I. Co., Hartford, Ct.

IRON BUILDINGS—
American Bridge Co., New York City.
Forest City Steel & Iron Co., Cleveland, O.
Riter-Conley Co., Pittsburg, Pa.
Wm. B. Scaife & Sons, Pittsburg, Pa.

IRON, NAILS AND STEEL—
C. H. Besly & Co., Chicago, Ill.

IRON AND STEEL ROOFING—
Berger Mfg. Co., Canton, O.
Wm. B. Scaife & Sons, Pittsburg, Pa.

IRON ORES—
Drake, Bartow & Co., Cleveland, O.
M. A. Hanna & Co., Cleveland, O.
Jerome Keeley & Co., Philadelphia, Pa.
Lake Superior Consolidated Iron Mines, New York City, N. Y.
Oglebay, Norton & Co., Cleveland, O.
Pickands, Brown & Co., Chicago, Ill.
Pickands, Mather & Co., Cleveland, O.
Tod, Stambaugh & Co., Cleveland, O.

IRON WORKING MACHINERY—
Atlas Machine Co., Pittsburg, Pa.

IRON WORKING TOOLS—
Armstrong Bros. Tool Co., Chicago, Ill.
The Armstrong Mfg. Co., Bridgeport, Conn.
Avery Stamping Co., Cleveland, O.
U. Baird Machinery Co., Pittsburg, Pa.
Bertsch & Co., Cambridge City, Ind.
C. H. Besly & Co., Chicago, Ill.
Bethlehem F'dry & Mach. Co., S. Bethlehem, Pa.
Bickford Drill & Tool Co., Cincinnati, O.
H. Bickford, Lakeport, N. H.
Jos. K. Bissell, Agt. Prentiss Tool & Supply Co., Pittsburg, Pa.
F. H. Bultman & Co., Cleveland, O.
Cleveland Punch & Shear Wks. Co., Cleveland.
Thos. P. Conard, Philadelphia, Pa.
Somers, Fitler & Clarke, Pittsburg, Pa.
Springfield Machine Tool Co., Springfield, O.
C. C. Wormer Machinery Co., Detroit, Mich.

LADLES—
Northern Engineering Works, Detroit, Mich.
S. Obermayer Co., Cincinnati., O., and Chicago.
Wm. B. Pollock Co., Youngstown, O.
The United Boiler Co., Girard, O.

LAG SCREWS—
Vulcanus Forging Co., Cleveland, O.

LATHES—
U. Baird Machinery Co., Pittsburg, Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Joseph E. Bissell, Agt. Prentiss Tool & Supply Co., Pittsburg, Pa.
Danielson Machine & Tool Co., Cleveland, O.
Somers, Fitler & Clarke, Pittsburg, Pa.
Springfield Machine Tool Co., Springfield, O.

LATHE TOOLS—
Armstrong Bros. Tool Co., Chicago, Ill.

LINK BELTING—
The Aultman Co., Canton, O.
The Jeffrey Mfg. Co., Columbus, O.
Link-Belt Machinery Co., Chicago, Ill.

LOCOMOTIVES—
Hyde Bros. & Co., Pittsburg, Pa.

LUBRICANTS—
The Ironsides Co., Columbus, O.
Wisconsin Graphite Co., Pittsburg, Pa.

LUBRICATING DEVICES—
The Lunkenheimer Co., Cincinnati, O.
Somers, Fitler & Clarke, Pittsburg, Pa.

MACHINE TOOLS—
American Engineering Works, Chicago, Ill.
Armstrong Bros. Tool Co., Chicago, Ill.
Atlas Machine Co., Pittsburg, Pa.
U. Baird Machinery Co., Pittsburg, Pa.
C. H. Besly & Co., Chicago, Ill.
Bertsch & Co., Cambridge City, Ind.
Bethlehem F'dry & Mach. Co., S. Bethlehem, Pa.
H. Bickford, Lakeport, N. H.
Bickford Drill & Tool Co., Cincinnati, O.
Joseph E. Bissell, Agt. Prentiss Tool & Supply Co., Pittsburg, Pa.
F. H. Bultman & Co., Cleveland, O.
Cleveland Punch & Shear Wks. Co., Cleveland.
Curtis & Curtis Co., Bridgeport, Conn.
Danielson Machine & Tool Co., Cleveland, O.
Pelton Engineering Co., Cleveland, O.
F. B. Shuster Co., New Haven, Conn.
Somers, Fitler & Clarke, Pittsburg, Pa.
Springfield Machine Tool Co., Springfield, O.
C. C. Wormer Machinery Co., Detroit, Mich.

MACHINE SCREWS—
C. H. Besly & Co., Chicago, Ill.
Somers, Fitler & Clarke, Pittsburg, Pa.

MACHINERY AND TOOL STEEL—
American Steel & Wire Co., Chicago, Ill.
C. H. Besly & Co., Chicago, Ill.
Crescent Steel Co., Pittsburg, Pa.
Monongahela Iron & Steel Co., Pittsburg, Pa.
Somers, Fitler & Clarke, Pittsburg, Pa.
Byron H. White, Chicago, Ill.

MAGNESIA COVERING—
C. H. Besly & Co., Chicago, Ill.

MALLEABLE CASTINGS—
Acme Steel & Malleable Iron Works, Buffalo, N. Y.
Link Belt Machinery Co., Chicago, Ill.
Meadville Malleable Iron Co., Meadville, Pa.

MANILLA ROPE—
A. Leschen & Sons Rope Co., St. Louis, Mo.

MANILLA ROPE COATING—
The Ironsides Co., Columbus, O.

MANUFACTURING CHEMISTS—
Grasselli Chemical Co., Cleveland, O.

METAL BEARINGS—
C. H. Besly & Co., Chicago, Ill.
J. J. Ryan & Co., Chicago, Ill.

METAL CEILINGS—
Berger Manufacturing Co., Canton, O.

METAL SAWS—
J. R. Vandyck, New York City, N. Y.

METAL WORK—
Avery Stamping Co., Cleveland, O.

MILL CASTINGS—
A. Garrison Foundry Co., Pittsburg, Pa.

MILLING MACHINES—
U. Baird Machinery Co., Pittsburg, Pa.
Danielson Machine & Tool Co., Cleveland, O.

MILLING MACHINERY—
Raymond Bros. Impact Pulverizer Co., Chicago.

MINING MACHINERY—
The Edward P. Allis Co., Milwaukee, Wis.
American Engineering Works, Chicago, Ill.
The Atlas Car & Mfg. Co., Cleveland, O.
C. H. Besly & Co., Chicago, Ill.
The Bucyrus Co., South Milwaukee, Wis.
Wm. Cramp & Sons, Philadelphia, Pa.
Fraser & Chalmers, Chicago, Ill.
Jeffrey Mfg. Co., Columbus, O.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Lidgerwood Mfg. Co., New York City.
Link Belt Machinery Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Wm. B. Pollock Co., Youngstown, O.
Raymond Bros. Impact Pulverizer Co., Chicago.
Thew Automatic Shovel Co., Lorain, O.
Torbert & Peckham, Chicago, Ill.
Webster, Camp & Lane Machine Co., Akron, O.

MINE CARS—
American Engineering Works, Chicago, Ill.

MINE LOCOMOTIVES—
Jeffrey Manufacturing Co., Columbus, O.

MINE PUMPS—
F. M. Prescott Steam Pump Co., Milwaukee, Wis.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.
Somers, Fitler & Clarke, Pittsburg, Pa.
Torbert & Peckham, Chicago, Ill.

MOLDING MACHINES—
S. Obermayer Co., Cincinnati, O., and Chicago.
Tabor Mfg. Co., Philadelphia, Pa.

MOLDING SAND—
John H. Ehlen, Newport, Ky.
Garden City Sand Co., Chicago, Ill.
Newport Sand Bank Co., Newport, Ky.
S. Obermayer Co., Cincinnati, O., and Chicago
Ohio Sand Co., Conneaut, O.
F. B. Stevens, Detroit, Mich.
Webster Foundry Sand Co., Philadelphia, Pa.

MOTORS—
Bullock Electric Mfg. Co., Cincinnati, O.

MULTIPLE DRILLS—
Bickford Drill & Tool Co., Cincinnati, O.
Jos. E. Bissell, Agt. Prentiss Tool & Supply Co., Pittsburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland.

NICKEL PLATING OUTFITS—
Northampton Emery Wheel Co., Chicago, Ill.

NUTS (SELF-LOCKING)—
National Elastic Nut Co., Milwaukee, Wis.

NUTS AND BOLTS—
National Elastic Nut Co., Milwaukee, Wis.
Milton Manufacturing Co., Milton, Pa.
Upson Nut Co., Cleveland, O.

OILLESS BEARINGS—
C. H. Besly & Co., Chicago, Ill.

OIL BURNERS—
Rockwell Engineering Co., New York City.

OIL CUPS—
C. H. Besly & Co., Chicago, Ill.
The Crane Co., Chicago, Ill.
The Lunkenheimer Co., Cincinnati, O.
Somers, Fitler & Clarke, Pittsburg, Pa.

OIL PUMPS—
C. H. Besly & Co., Chicago, Ill.
The Lunkenheimer Co., Cincinnati, O.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

OIL STORAGE TANKS—
Wm. B. Pollock Co., Youngstown, O.

OIL SEPARATORS—
Harrison Safety Boiler Works, Philadelphia.

OIL TANKS AND CARS—
Wm. B. Pollock Co., Youngstown, O.

ORE BARROWS—
The Atlas Car & Mfg. Co., Cleveland, O.

ORE CARS—
American Engineering Works, Chicago, Ill.
The Atlas Car & Mfg. Co., Cleveland, O.
The Pressed Steel Car Co., Pittsburg, Pa.

ORE CRUSHERS—
The Edward P. Allis Co., Milwaukee, Wis.
The Aultman Co., Canton, O.
Fraser & Chalmers, Chicago, Ill.
Jeffrey Mfg. Co., Columbus, O.

ORE HANDLING MACHINERY—
The Atlas Car & Mfg. Co., Cleveland, O.
Jeffrey Manufacturing Co., Columbus, O.
A. Leschen & Sons Rope Co., St. Louis, Mo.

ORE SCREENS—
Rob't Aitchison Per. Metal Co., Chicago, Ill.
American Engineering Works, Chicago, Ill.
The Aultman Co., Canton, O.
Fraser & Chalmers, Chicago, Ill.
Hendrick Mfg. Co., Carbondale, Pa.

ORE TESTING MACHINERY—
Keystone Driller Co., Beaver Falls, Pa.

ORNAMENTAL IRON WORK—
Forest City Steel & Iron Co., Cleveland, O.

PACKING—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.
A. Leschen & Sons Rope Co., St. Louis, Mo.

PAINT—
Jos. Dixon Crucible Co., Jersey City, N. J...
The Ironsides Co., Columbus, O.
Wisconsin Graphite Co., Pittsburg, Pa.

PAINT MACHINES—
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.

PATTERN WORKS—
Balkwil Pattern Works, Cleveland, O.
C. Birnbaum, Cleveland, O.
Gobeille Pattern Co., Cleveland, O.

PERFORATED METALS—
Aitchison Perforated Metal Co., Chicago, Ill.
Fraser & Chalmers, Chicago, Ill.
Hendrick Mfg. Co., Carbondale, Pa.

PIG IRON—
Alabama Consolidated Coal & Iron Co., Birmingham, Ala.
American Steel Hoop Co., Pittsburg, Pa.
American Steel & Wire Co., Chicago, Ill.
Reed F. Blair & Co., Pittsburg, Pa.
Bourne-Fuller Co., Cleveland, O.
Cabeen Co., Philadelphia, Pa.
Cherry Valley Iron Co., Pittsburg, Pa.
Clinton Iron & Steel Co., Pittsburg, Pa.
Columbus Iron & Steel Co., Pittsburg, Pa.
Crerar Clinch Co., Chicago, Ill.
A. M. Crane & Co., Chicago, Ill.
The Rob't Field Co., Columbus, O.
M. A. Hanna & Co., Cleveland, O.
Hickman, Williams & Co., Chicago, Ill.
J. H. Hillman & Son., Pittsburg, Pa.
Jerome Keeley & Co., Philadelphia, Pa.
McKeefrey & Co., Leetonia, O.
Pickands, Brown & Co., Chicago, Ill.
Pickands, Mather & Co., Cleveland, O.
Pilling & Crane, Philadelphia, Pa.
Republic Iron & Steel Co., Chicago, Ill.
Sloss Sheffield Steel & Iron Co., Birmingham, Ala.
Spearman Iron Co., Sharpsville, Pa.
F. B. Stevens, Detroit, Mich.
Superior Charcoal Iron Co., Grand Rapids, Mich.
Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.

PIPE (CAST IRON)—
A. M. Crane & Co., Chicago, Ill.
Massillon Iron & Steel Co., Chicago, Ill.

PIPE (RIVETED STEEL)—
A. M. Crane & Co., Chicago, Ill.
Wm. B. Pollock Co., Youngstown, O.
Wm. B. Scaife & Sons, Pittsburg, Pa.
Somers, Fitler & Clarke, Pittsburg, Pa.

PIPE COVERING—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.

PIPE CUTTING AND THREADING MACHINES—
The Armstrong Mfg. Co., Bridgeport, Conn.
Somers, Fitler & Clarke, Pittsburg, Pa.

PIPE FITTERS—
The Best Manufacturing Co., Pittsburg, Pa.
Pittsburg Valve, Fdy. & Construc. Co., Pittsburg, Pa.

PISTON AIR DRILLS—
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.

PISTON RODS—
Bethlehem Steel Co., South Bethlehem, Pa.

PLANERS—
Atlas Machine Co., Pittsburg, Pa.
U. Baird Machinery Co., Pittsburg, Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Danielson Machine & Tool Co., Cleveland, O.
Somers, Fitler & Clarke, Pittsburg Pa.
Springfield Machine Tool Co., Springfield, O.

PLANER TOOLS—
Armstrong Bros. Tool Co., Chicago, Ill.

PLANISHED IRON—
American Sheet Steel Co., New York City.

PLATES—
American Steel & Wire Co., Chicago, Ill.
A. M. Crane & Co., Chicago, Ill.
Enterprise Boiler Co., Youngstown, O.
Republic Iron & Steel Co., Chicago, Ill.

PLUMBERS' AND GAS FITTERS' SUPPLIES—
C. H. Besly & Co., Chicago, Ill.
The Crane Co., Chicago, Ill.

PNEUMATIC TOOLS—
American Engineering Works, Chicago, Ill.
Cleveland Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.

PORTABLE FORGE—
C. H. Besly & Co., Chicago, Ill.
Somers, Fitler & Clarke, Pittsburg, Pa.
Vulcan Mfg. Co., Pittsburg, Pa.

POWER PRESSES—
Avery Stamping Co., Cleveland, O.
Bertsch & Co., Cambridge City, Ind.
Bethlehem Fdy & Mach. Co., S. Bethlehem, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland.
Danielson Machine & Tool Co., Cleveland, O.

POWER TRANSMISSION MACHINERY—
American Engineering Works, Chicago, Ill.
The Aultman Co., Canton, O.
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
I. & E. Greenwald Co., Cincinnati, O.
Jeffrey Mfg. Co., Columbus, O.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Link Belt Machinery Co., Chicago, Ill.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

PRESSED STEEL CARS—
Pressed Steel Car Co., Pittsburg, Pa.

PRESSES—
Atlas Machine Co., Pittsburg, Pa.
Avery Stamping Co., Cleveland, O.
Bertsch & Co., Cambridge City, Ind.
C. H. Besly & Co., Chicago, Ill.
Bethlehem F'dry & Mach. Co., S. Bethlehem, Pa.
Jos. E. Bissell, Agt. Prentiss Tool & Supply Co., Pittsburg, Pa.
Cleveland Punch & Shear Wks. Co., Cleveland.
Danielson Machine & Tool Co., Cleveland, O.
R. D. Wood & Co., Philadelphia, Pa.

PRESSURE GAUGES—
The Bristol Co., Waterbury, Conn.

PULLEYS—
The Aultman Co., Canton, O.
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
I. & E. Greenwald Co., Cincinnati, O.
Jeffrey Mfg. Co., Columbus, O.
W. A. Jones Foundry Co., Chicago, Ill.
A. Leschen & Sons Rope Co., St. Louis, Mo.
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Somers, Fitler & Clarke, Pittsburg, Pa.
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PULVERIZING MACHINERY—
Raymond Bros. Impact Pulverizer Co., Chicago.

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Blakeslee Mfg. Co., Du Quoin, Ill.
The Deming Co., Salem, O.
Fred M. Prescott Steam Pump Co., Milwaukee, Wis.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.
Torbert & Peckham, Chicago, Ill.
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PURIFIERS—
Wm. B. Scaife & Sons, Pittsburg, Pa.

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Edward Brown, Philadelphia, Pa.
Vulcan Mfg. Co., Pittsburg, Pa.

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A. Garrison Foundry Co., Pittsburg, Pa.
Geo. B. Sennett Co., Youngstown, O.
Totten & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
The United Boiler Co., Girard, O.
West Penn Foundry & Machine Co., Avonmore, Pa.

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Link Belt Machinery Co., Chicago, Ill.
Somers, Fitler & Clarke, Pittsburg, Pa.
Waterbury Rope Co., New York City.

ROTARY BREAST DRILLS—
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Pneumatic Tool Co., Cleveland, O.

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Robt. Aitchison Perforated Metal Co., Chicago.
The Aultman Co., Canton, O.
Fraser & Chalmers, Chicago, Ill.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus, O.
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Chicago Screw Co., Chicago, Ill.
Upson Nutt Co., Cleveland, O.

SECOND-HAND MACHINERY—
The Atlas Machine Co., Pittsburg, Pa.
Jos. E. Bissell, Agt. Prentiss Tool & Supply Co., Pittsburg, Pa.
The W. J. Carlin Co., Pittsburg, Pa.
Hyde Bros. & Co., Pittsburg, Pa.
Pelton Engineering Co., Cleveland, O.
Joseph Schonthal, Pittsburg, Pa.
Torbert & Peckham, Chicago, Ill.
C. C. Wormer Machinery Co., Detroit, Mich.

SEAMLESS STEEL TUBES—
Shelby Steel Tube Co., Cleveland, O.

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Harrison Safety Boiler Works, Philadelphia.

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SHAFTING—
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American Engineering Works, Chicago, Ill.
American Steel & Wire Co., Chicago, Ill.
Atlas Machine Co., Pittsburg, Pa.
The Aultman Co., Canton, O.
Bethlehem Steel Co., South Bethlehem, Pa.
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
Fitzsimmons & Co., Cleveland, O.
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Bethlehem F'dry & Mach. Co., S. Bethlehem, Pa.
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Danielson Machine & Tool Co., Cleveland, O.
R. D. Wood & Co., Philadelphia, Pa.

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Springfield Machine Tool Co., Springfield, O.

SHEAR KNIVES—
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American Sheet Steel Co., New York City.
American Steel & Wire Co., Chicago, Ill.
Republic Iron & Steel Co., Chicago, Ill.

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Samuel Trethewey & Co., Pittsburg, Pa.

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Danielson Machine & Tool Co., Cleveland, O.
Gearing & Hoerle, Allegheny, Pa.
Jeffrey Mfg. Co., Columbus, O.
Wheeling Mold & F'dry Co., Wheeling, W. Va.

STACKS—
Wm. B. Scaife & Sons, Pittsburg, Pa.

STAIRS (IRON AND STEEL)—
Forest City Steel & Iron Co., Cleveland, O.

STAND PIPES—
The Wm. B. Pollock Co., Youngstown, O.
The United Boiler Co., Girard, O.

STEAM BOILER INSPECTORS—
Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn.

STEAM HAMMERS—
American Engineering Works, Chicago, Ill.

STEAM PIPE AND BOILER COVERING—
C. H. Besly & Co. Chicago, Ill.

STEAM PACKING—
C. H. Besly & Co., Chicago, Ill.

STEAM PUMPS—
Edw. P. Allis Co., Milwaukee, Wis.
Blakeslee Mfg. Co., Du Quoin, Ill.
The Deming Co., Salem, O.
Fred. M. Prescott Steam Pump Co., Milwaukee, Wis.
Southwark Foundry and Machine Co., Philadelphia, Pa.
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Torbert & Peckham, Chicago, Ill.
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STEAM SEPARATORS—
Austin Separator Co., Detroit, Mich.
Harrison Safety Boiler Works, Philadelphia.
Wright Manufacturing Co., Cleveland, O.

STEAM SHOVELS AND DREDGES—
The Bucyrus Co., South Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.
The Thew Automatic Shovel Co., Lorain, O.
Torbert & Peckham, Chicago, Ill.

STEAM SPECIALTIES—
C. H. Besly & Co., Chicago, Ill.
The Lunkenheimer Co., Cincinnati, O

STEEL—
American Steel Hoop Co., New York City.
American Steel & Wire Co., Chicago, Ill.
Cabeen Co., Philadelphia, Pa.
Champion Iron & Steel Co., Muskegon, Mich.
A. M. Crane & Co., Chicago, Ill.
Crescent Steel Co., Pittsburg, Pa.
Forest City Steel & Iron Co., Cleveland, O.
Monongahela Iron & Steel Co., Pittsburg, Pa.
Otis Steel Co., Cleveland, O.
Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
Byron H. White, Chicago, Ill.

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STEEL BLOOMS AND BILLETS—
American Steel Hoop Co., New York City.
American Steel & Wire Co., Chicago, Ill.
Bethlehem Steel Co., South Bethlehem, Pa.
Cabeen Co., Philadelphia, Pa.
Champion Iron & Steel Co., Muskegon, Mich.
A. M. Crane & Co., Chicago, Ill.
Jerome Keeley & Co., Philadelphia, Pa.
The Lorain Steel Co., Lorain, O.
National Steel Co., Chicago, Ill.
Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.

STEEL CARS—
American Engineering Works, Chicago, Ill.
The Pressed Steel Car Co., Pittsburg, Pa.

STEEL CASTINGS—
Acme Steel & Malleable Iron Works, Buffalo, N. Y.
Bethlehem Steel Co., South Bethlehem, Pa.
Otis Steel Co., Cleveland, O.
The Sargent Co., Chicago, Ill.

STEEL CEILINGS—
Berger Manufacturing Co., Canton, O.

STEEL FRAME MILL BUILDINGS—
American Bridge Co., New York City.
Pittsburg Steel Construction Co., Pittsburg, Pa
Wm. B. Scaife & Sons, Pittsburg, Pa.

STEEL HOOPS—
American Steel Hoop Co., New York City.

STEEL PLANTS—
The Wm. B. Pollock Co., Youngstown, O.
The Riter-Conley Co., Pittsburg, Pa.

STEEL SHEETS—
American Sheet Steel Co., New York City.
American Steel & Wire Co., Chicago, Ill.
Republic Iron & Steel Co., Chicago, Ill.

STEEL STAMPS—
F. A. Sackmann, Cleveland, O.

STENCILS—
F. A. Sackmann, Cleveland, O.

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The Crane Co., Chicago, Ill.
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TANKS—
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Enterprise Boiler Co., Youngstown, O.
Meehan Boiler & Construction Co., Lowellville, O.
The Wm. B. Pollock Co., Youngstown, O.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Wm. B. Scaife & Sons, Pittsburg, Pa.
The United Boiler Co., Girard, O.

TANK CARS—
Wm. B. Pollock Co., Youngstown, O.

TESTING MACHINERY—
Keystone Driller Co., Beaver Falls, Pa

TIN AND TERNE PLATES—
American Tin Plate Company, New York City.
Champion Iron & Steel Co., Muskegon, Mich.

TIN PLATE MACHINERY—
Canton Roll & Machine Co., Canton, O.
Totten & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
West Penn Foundry & Machine Co., Avonmore, Pa.

TOOL HOLDERS—
Armstrong Bros. Tool Co., Chicago, Ill.

TOOL STEEL—
American Steel & Wire Co., Chicago, Ill.
C. H. Besly & Co., Chicago, Ill.
Crescent Steel Co., Pittsburg, Pa.
Monongahela Iron & Steel Co., Pittsburg, Pa
Somers, Fitler & Clarke, Pittsburg, Pa.

TORCHES—
Somers, Fitler & Clarke, Pittsburg, Pa.

TRAMWAYS—
The Atlas Car & Mfg. Co., Cleveland, O.
A. Leschen & Sons Rope Co., St. Louis, Mo.

TRANSMISSION MACHINERY—
American Engineering Works, Chicago, Ill.
The Aultman Co., Canton, O.
The Brown Hoisting Machinery Co., Cleveland, O.
Dodge Mfg. Co., Mishawaka, Ind.
Jeffrey Mfg. Co., Columbus, O.
W. A. Jones Foundry & Machine Co., Chicago.
Link Belt Machinery Co., Chicago, Ill.

TRANSMISSION ROPE (WIRE)—
American Steel & Wire Co., Chicago, Ill.

TROLLEY TRACKS—
The Atlas Car & Mfg. Co., Cleveland, O.
Northern Engineering Works, Detroit, Mich.

TROLLEY WIRES—
American Steel & Wire Co., Chicago, Ill.

TRUCKS—
American Engineering Works, Chicago, Ill.
The Atlas Car & Mfg. Co., Cleveland, O.
Northern Engineering Works, Detroit, Mich.
Pressed Steel Car Co., Pittsburg, Pa.

TUBES—
S. Fix' Sons, Cleveland, O.
National Tube Co., Pittsburg, Pa.
Shelby Steel Tube Co., Cleveland, O.

TUBE WELDING—
S. Fix' Sons, Cleveland, O.

TUMBLERS—
Northern Engineering Works, Detroit, Mich.

TURBINE WATER WHEELS—
Stilwell-Bierce & Smith Vaile Co., Dayton, O.

TURNBUCKLES—
Ceveland City Forge & Iron Co., Cleveland, O.
Republic Iron & Steel Co., Chicago, Ill.
Somers, Fitler & Clarke, Pittsburg, Pa.

TWIST DRILLS—
C. H. Besly & Co., Chicago, Ill.

TWIST DRILL CASES—
Somers, Fitler & Clarke, Pittsburg, Pa.
Vulcan Mfg. Co., Pittsburg, Pa.

VALVES—
C. H. Besly & Co., Chicago, Ill.
The Best Manufacturing Co., Pittsburg, Pa.
The Lunkenheimer Co., Cincinnati, O.
Jenkins Bros., New York City.
Pittsburg Valve Foundry & Construction Co., Pittsburg, Pa.
Somers, Fitler & Clarke, Pittsburg, Pa.
Vincent Valve Co., Sandusky, O.

VISES—
Emmert Mfg. Co., Waynesboro, Pa.

WASHERS—
Avery Stamping Co., Cleveland, O.
Milton Manufacturing Co., Milton, Pa.
Somers, Fitler & Clarke, Pittsburg, Pa.

WATER COLUMNS—
Somers, Fitler & Clarke, Pittsburg, Pa.

WATER PIPE—
Massillon Iron & Steel Co., Chicago, Ill.

WATER SOFTENING PLANTS—
Pittsburg Filter Mfg. Co., Pittsburg, Pa.
Wm. B. Scaife & Sons, Pittsburg, Pa.

WIRE—
American Steel & Wire Co., Chicago, Ill.
Summit Wire Co., Cuyahoga Falls, O.

WIRE COATING—
The Ironsides Company, Columbus, O.

WIRE FENCING—
American Steel & Wire Co., Chicago, Ill.

WIRE FILLER—
The Ironsides Co., Columbus, O.

WIRE GOODS—
F. B. Shuster Co., New Haven, Conn.

WIRE MACHINERY—
S. W Goodyear, Waterbury, Conn.
F. B. Shuster Co., New Haven, Conn.

WIRE NAILS—
American Steel & Wire Co., Chicago, Ill.

WIRE ROPE—
American Steel & Wire Co., Chicago, Ill
A. Leschen & Sons Rope Co., St. Louis, Mo.
Somers, Fitler & Clarke, Pittsburg, Pa.
Waterbury Rope Co., New York City.

WIRE ROPE COATING—
The Ironsides Company, Columbus, O.
Somers, Fitler & Clarke, Pittsburg, Pa.

WIRE ROPE FILLING—
The Ironsides Co., Columbus, O.

WOOD PULLEYS—
Dodge Mfg. Co., Mishawaka, Ind.
Somers, Fitler & Clarke, Pittsburg, Pa.

WROUGHT PIPE—
The Crane Co., Chicago, Ill.
National Tube Co., Pittsburg, Pa.
Pittsburg Valve Foundry & Construction Co., Pittsburg, Pa.
Somers, Fitler & Clarke, Pittsburg, Pa.

Alphabetical List of Advertisers.

The star (*) indicates that the adv. appears alternate weeks; the dagger (†) once a month; the double dagger (‡) once in three weeks; the parallel (‖) three times out of four.

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